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CONTENTS.

Editorial 45
The Chicago Electrical Association 47
Trolley Extensions in Brooklyn 47
Magnetic Leakage in Dynamos 47
A Method for the Detection of Weak Dynamo Fields, by Buckner Speed 48
An Ingenious Japanese Contrivance 48
Central-Station Working—II., by James B. Foote 49
Centralization of Transmitter-Batteries in Telephone Exchanges, by Kempster B. Miller 52
Researches on Alternating-Current Arcs, by H. Görges 53
The Effective Centre of Light from a Standard Photometric Burner, by Clayton H. Sharp 54
Storage Batteries 54
The Geometrical Form of Transformer Plates, by George Adams 55
New Brown Three-Phase Generator 56
Errors in Testing 57
A Critic Criticised, by James F. McElroy 58
THE ELECTRICAL WORLD Index, by William Esty 58
Theories of Magnetism, by Henry Greenway 58
Digest of Current Technical Electrical Literature, Compiled by Carl Hering 59
New Book 62
Railway Wattmeters 63
Automatic Expansion Packing 63

DEPARTMENTS:

Financial Intelligence 64
Special Correspondence 64
General News of the Week 65
Trade and Industrial Notes 66
Business Notices 67
Illustrated Record of Electrical Patents 67

THE RECORD AGAIN BROKEN.

The issue of THE ELECTRICAL WORLD of last week was the largest number of an electrical journal ever published in any country. It contained no less than 136 pages, exclusive of the 12-page index of the preceding volume. It was also the largest edition of any electrical periodical ever printed, numbering 18,000 copies, and requiring 315 reams of paper, weighing 10 1 tons, this also exclusive of the index. As another criterion of the size of the paper, and one serving to measure its business growth, we give a comparison of the advertising in this great issue with that in other record-breaking numbers:

	Pages.	Number of Advertisements.	Inches of advertising.
March 7, 1891	42	301	2099
February 27, 1892	52	357	2613
March 4, 1893	56	378	2828
March 3, 1894	76	386	3215
January 5, 1895	88	395	3781
January 4, 1896	92	406	3804

A gratifying deduction from the amount of advertising contained in the first number of the new year is that those connected with electrical industries enter upon another year in an enterprising and vigorous spirit promising well for the future.

CENTRALIZED TELEPHONE BATTERIES.

The article elsewhere in this issue by Mr. Kempster B. Miller on the centralization of telephone-transmitter batteries in the telephone exchange is one of much interest, and perhaps for the first time presents the matter in such a form as to be easily understood by other than telephone experts. Diagrams that accompany telephonic exchange patents are usually so involved as to require an expert knowledge of the entire art to make them intelligible, and as these are ordinarily the only source of information, the writer of the present article has performed a real service in reconstructing the ones relating to the present subject, so as to include only the actual principles concerned. The value of methods by means of which local telephone primary batteries may be displaced is evident, and those proposed have much interest besides from the ingenious nature of the solutions which they offer to the problem. The substitution of storage batteries for the present primary cells, to which the writer refers, to be charged while the line is not in use, presents a difficulty with respect to the rate of charge. Experience in continuously charging storage batteries with relatively feeble currents has not been a happy one, that method seeming to involve a real difficulty, from the sulphating of plates. It has been found that with small charging currents sulphating of storage batteries proceeds rapidly, and though evil effects may be reduced by an occasional "health" overcharge at a high rate, yet in the case of phonograph and medical batteries the deterioration of plates even then has been excessive. Moreover, the opinion that storage batteries installed for telephonic purpose will require practically no attention is one that it will be not easy to justify, for while the amount of care required may not be onerous, yet it will probably largely exceed that given to the primary batteries displaced. The storage battery has suffered much in the past from misapplication and misuse, and in the future it will be well to more carefully consider the conditions involved before making new applications. Our remarks, of course, only apply to the use of the storage battery with subscribers' sets where the primary battery is now employed; for exchange work, sub-stations and where considerable current is required, and the battery can be charged at a normal rate, there is no question of its applicability.

ALTERNATING-CURRENT ARCS.

In the Digest will be found an abstract of a recent paper by Prof. Fleming on the alternating-current arc, in which it is stated that the experiments forming the basis of the paper amply justify the opinion generally held, that the alternating current is less efficient than the continuous current in producing the arc light, though, it is added, the experiments do not exhaust the subject or definitely determine the question. Very curiously, Prof. Fleming considers that it is a matter of too purely an academic interest to make it worth while to spend time on the question whether any particular form of alternating-current arc can be produced equaling in efficiency the continuous current arc. How great an influence the form of alternating-current curve has on the efficiency of an arc is shown in an article in another column by a German experimenter. He found that with a 12-ampere lamp and a frequency of 50 periods per second, a flat-current curve gave a mean spherical intensity of .960 Hefner units per watt, while with a pointed curve the corresponding quantity was only .796—making a difference of 20 per cent. in favor of the former. The percentage is still greater in favor of the former if we consider hysteresis losses, as Steinmetz has shown that these are greater with a flat than a pointed-current curve. This follows from the fact that a flat-current curve produces a pointed curve of magnetic flux, which has a lesser ratio between the area and the maximum value of the flux than a flat curve, the former being a measure of the energy and the latter of the hysteresis loss. The two explanations offered for the higher efficiency of the flatter curves do not appear to be very conclusive. One is that, owing to the longer period during which there is a large current with a flat curve, the carbons cool less than with a pointed curve, but whether such a difference in cooling would be significant seems improbable. The other explanation, that the eye may measure different mean values of light, owing to the different forms of light curves, is also an assumption not particularly appealing. If no better reasons can be given for the relative inefficiency of the alternating-current arc, such efficiency cannot be considered as yet definitely established, for tests of continuous-current arcs have demonstrated that differences of 50 per cent. in efficiency may result from the use of different carbons. It is not unreasonable to suppose, also, that a carbon efficient with one form of alternating current may be less efficient with another. A series of tests would be of interest, and perhaps of importance, in which different carbons would be tried, and comparative tests then made with the continuous current and different forms of alternating currents, using in each case the carbon which, in preliminary tests, had been found to give the maximum result for each of the several arcs.

STEAM ECONOMY IN CENTRAL STATIONS.

The article by Mr. James B. Foote on central-station working elsewhere in this issue, brings up a number of points of interest, and particularly several relating to steam economy. The test referred to in regard to the relative efficiencies of double and triple expansion engines is an instructive one, involving as it does the principle of multiple expansion. It cannot be too much impressed upon engine-users that the relative efficiencies of multiple-expansion engines is inseparable from that of steam pressures. Isherwood about 40 years ago demonstrated that there was no economy, but an actual loss, in more than about six expansions in a single cylinder. As higher steam-pressures began to be used the greater number of expansions entailed were divided between two or more cylinders, and only for the reason given. At a steam-pressure of less than, say, 120 pounds per square inch there is no reason for using the triple-expansion engine, while for a pressure of, say, 160 pounds this type is necessary for efficiency, and for pressures above 200 pounds the quadruple-expansion engine is called for. The efficiency of the steam engine depends, firstly, upon the limits of temperature between which the steam is worked, and secondly, upon the efficiency of working. Under the first condition a triple-expansion engine is no more efficient than a simple engine, so that the controlling factor is the efficiency in working, which depends upon the number of expansions in a cylinder which makes the type of engine a function of the steam-pressure alone. The idea of pressure should, therefore, never be separated from the type of engine. The instance quoted by Mr. Foote does not prove that the triple-expansion engine is not more efficient than the so-called compound type, but merely that it was tried under a steam-pressure not sufficiently high to bring out its superior efficiency. The good results achieved from the use of dry steam are suggestive, but still better economy would undoubtedly be obtained if the steam were superheated. There is no direction, in fact, from which better returns may be expected than through superheating, and it is quite probable that the time is not far distant when this means of economy will be largely availed of, and the superheater made part of every boiler plant. The failures with superheating when the subject first came up, 30 years or more ago, were largely due to the methods then used. Owing to improper design and construction, the superheating apparatus rapidly deteriorated, and the animal and vegetable substances used for cylinder lubrication were unfavorably affected by the high temperature of the steam. At the present day no difficulty would be experienced with respect to apparatus, and the mineral lubricants now largely used in cylinders will stand high temperatures, if, indeed, at the present time lubrication is at all necessary. The method described of heating feed-water has an advantage over the use of live steam, but has the disadvantage of reducing the power of the engine and also, at light loads, of reducing the efficiency of the low-pressure cylinder. While the former consideration only has weight at hours of heavy load, yet the method should only be considered a makeshift. The ideal method is to heat feed-water, with the furnace gases after they have left the boiler surfaces, and apparatus should be installed for this purpose in all important installations. Should this method result in decreased draft through the lowering of the chimney temperature, a fan run by an electric motor can be used to assist the draft when necessary, for the amount of energy thus used during hours of heavy load will undoubtedly be much less than the saving of heat that otherwise during the day would pass up the chimney.

The Engineer of To-Day.

Prof. Ira N. Hollis in an article in the *Harvard Graduates Magazine* for December on "Engineering and Harvard University" says that we may group the engineers now working side by side for the development of our material sources into three classes. First, those men, many of them eminent in the profession, who are the product of the workshop; whose experience and education have been obtained entirely in the field or workshop, and from the few books available early in the century. To them we owe the means of rapid communication and transportation which have cemented the United States into a great nation, and to the chronicle of their successes and mistakes is due, in a large measure, the advantages of our young graduates who now go forth with an equipment almost equal to that attained by our forefathers in the better part of a lifetime. Second, men who have graduated from the literary or natural science departments of our colleges, and have learned engineering after leaving school. This class has been produced by strong taste for the profession or by pressure of circumstances. Frequently, some lucky invention has given them the leaning toward practical work. Third, the younger men, graduated from schools avowedly technical or from the technical departments of universities. These men are gradually supplanting the other two classes, as the demand for greater attainment and better education increases, and as competition and the invention of labor-saving machinery turns the mechanic into a laborer, and raises the status of the educated engineer.

The above classification, Prof. Hollis says, is roughly drawn, as there are graduates of 60 years and upward from a few technical schools founded early in the century, and again, men going from the workshop into the office; but the fact remains that the latter class are finding the change more and more difficult. The next generation, Prof. Hollis believes, will see the men with only workshop or academic training practically cut off from the profession of engineering.

The Chicago Electrical Association.

The Chicago Electrical Association held its third meeting for this season at Monadnock Building, on Jan. 3. The paper of the evening was by W. Clyde Jones on the "Protection of an Invention," and was a very concise and complete statement of facts regarding American patent laws and customs. The discussion which followed was participated in by W. R. Garton, Thos. G. Grier, S. B. Jamieson and others.

Following the paper the election of officers for the ensuing year was held and resulted in the election of W. Clyde Jones, president; S. G. McMeen, vice-president; J. R. Cravath, secretary, and F. S. Hickok, treasurer. There has recently been a great increase in interest and membership of the association, and it promises to take a prominent place among the local professional societies of Chicago.

Trolley Extensions in Brooklyn.

President Rossiter, of the Brooklyn Heights Railway Company, says that early in 1896 his company will be ready to spend a large amount of money to improve its system. A large brick repair shop will be built in South Brooklyn, and the company has bought over several thousand tons of 90-pound steel rails to be delivered during the Winter months, and will thus provide for reconstruction of part of the roadway, and the Sumner Avenue line will be extended to Bergen Beach.

The Douglass Street line of the Nassau Company will be extended to Hamilton Ferry. The Thirty-ninth Street ferry line will be extended to Flatbush and Flatlands, and the Fifth Avenue line to Fort Hamilton, through Bay Ridge to Bensonhurst. The Coney Island & Brooklyn Road will put on 25 new cars and will reduce the fare to Coney Island and return from 25 cents to 15 cents or 10 cents each way. The Nassau Company is reported to have decided to reduce its rate of fare from 5 to 4 cents.

A Venezuelan Water-Power.

On New Year's Day Mr. Ricardo Zuloaga, of the Compania Anonima La Electricidad, Caracas, Venezuela, visited Niagara Falls to inspect the power-plant and method of power development at Niagara, in order to obtain information bearing on the best method of development of 3000 hp at the Falls of St. Encantada, Venezuela, the power to be transmitted from there to Caracas, a city having a population of about 100,000 inhabitants. At the point where it is expected to develop this power, Mr. Zuloaga stated there are two falls, each quite high, but not of great volume or capacity. These falls are formed by the El Guaire River. One is 120 feet high and is located about 10 miles from Caracas, while the other is 225 feet in height and 12 miles away from the city that expects to be benefited by this latest power project. It is expected that the first fall referred to will develop about 1000 hp, and that the other will give at least 2000 hp. In the development of this power a canal would be used, the plan being something of the nature of the Niagara Falls Hydraulic Power & Mfg. Company's plant at Niagara. Electricians who contemplate going to Venezuela to get the contract for this plant, or any part of it, will be interested in Mr. Zuloaga's statement that "a man can live very comfortably in my country on about $135 a month—that is, if he is a single man."

Electrical Production of Chlorate of Potash.

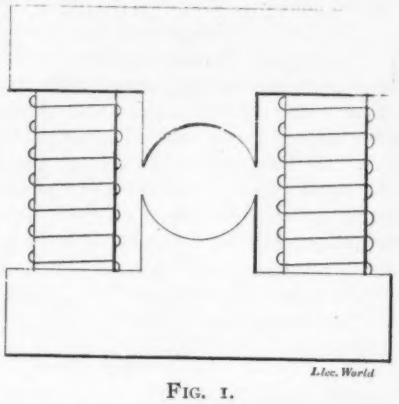
It is officially announced that a contract has been made between the Niagara Falls Power Company and Mr. Walter Ferguson, of New York City, under the terms of which Mr. Ferguson will immediately build a factory on the Power Company's lands for the production of chlorate of potash. The site has been selected and is located about 200 feet to the east of the new calcic carbide plant. It, like all the other factories built and in course of building, is located on the line of the Junction Railway, and includes one acre of ground, with an option to increase. The plant is to be erected at once. The first delivery of power will be 500 hp, the contract calling for an additional amount up to 3500 hp. This makes four factories under way on the Power Company's lands, and more contracts are under consideration and likely to be announced any day.

Applicable to Electrical Engineers Also.

Our contemporary, the *Engineering News*, makes the following statement: "We fear that most engineers are so busy making history that they have not time to write it—or even to read it."

Magnetic Leakage in Dynamos.

To designers who know how to compute permeance and leakage coefficients, this article will have nothing to tell, but as there is a class of station managers whose misconceived ideas on this subject sometimes cause them to wrongfully condemn certain types of machines, a simple practical discussion of this may be useful. A fundamental practical consideration is that it makes no difference to the user of a dynamo how its losses are distributed, provided they do not interfere with the cool, quiet and sparkless running of the machine. Particularly does this apply to field magnets. The station manager, seeing a machine whose prominent parts are highly charged with magnetism, makes up his mind that the machine is highly inefficient, whereas it may be, and frequently is, more efficient than some other type which he is wont to praise. Prominent among the machines receiving this unjust criticism, is the consequent pole type, a sketch which is shown in Fig. 1. The leakage of this machine is not any greater than that of the other types, the coefficient varying from 155 to 1.28, according to



Elec. World

FIG. 1.

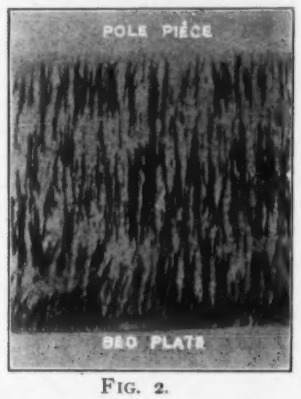


FIG. 2.

the size. However, the rails, bearings, bolts and all of the upper part are always highly magnetic, and, in this respect, are sure to attract the notice of any one handling the machine. The reason is very simply explained by the fact that the exposed portions are the pole-pieces of the machine, or projections thereof, and, therefore, it is to be expected that they will be highly magnetic, for that is true of any dynamo machine. The pole-pieces are merely more prominently in view, and, therefore, the leakage of magnetism is more readily noticed. There are other machines which apparently have but little leakage, but are quietly and in an unobserved way pouring a large flux of magnetic lines through other paths than through the armature core. Fig. 2 shows an experiment performed on a very popular and economical type. A piece of paraffined paper was placed across a gap where it was suspected that leakage existed and was sprinkled with iron filings. Heating the paper melted the paraffine and on cooling the filings became set, and, as will be noticed, indicate a strong leakage. It should be remembered that it is the actual current taken by the field rather than the apparent wasted magnetism that is the measure of economy. To judge of the waste of magnetism of a machine by the power to attract wrenches and bits of iron is the crudest sort of guesswork. So long as the magnetizing current in machines of different type but the same rating is the same, it makes no difference how relatively powerful or weak the exposed portions of the field magnet of one or the other may attract iron, provided this magnetism does not prove an inconvenience other wise.

Niagara Extension.

The bids which the Niagara Falls Power Company has asked for the extension of its wheel-pit are to be filed in the company's office, Mills Building, New York, on or before the 13th inst., at which time the proposals will be considered and the contract awarded. The work will cost fully a million dollars.

Calcium Carbide.

A recently published circular states that this material can be produced by the Electro-Gas Company commercially at $20 per ton, and in the near future "without the aid of electricity" at $7 to $10 per ton. In that case the company had better change its name.

A Method for the Detection of Weak Dynamo Fields.

BY BUCKNER SPEED.

The cotton covering of the wire wound on dynamo fields is subject to deterioration from three principal causes—slow carbonization, due to heat; oil from the bearings, and insufficiently baked shellac. These changes in the insulation of the wire allow the current to pass from layer to layer of the wire instead of all passing through the wire itself, and the field may thereby be greatly weakened, and yet show no ground from the field wire to the field core. The only cure for such weakening is to rewind the spool with new wire.

The spool or spools requiring rewinding may usually be determined with ease if the resistance of each spool be taken when first received from the factory. If, however, the original resistances cannot be obtained, and there is no certainty that the coils all had equal resistances when wound, the faulty coil may be determined as follows :

Measure the resistance of each spool with a Weston voltmeter and Weston ammeter, using currents of various strengths; thus in the measurement of an arc machine the field wire would be connected in series with a Weston ammeter and adjustable resistances for varying the current, which could be supplied from a constant potential generator, for example. The drop across each spool would then be taken with a Weston voltmeter, when the current is held steadily at one ampere, then at two amperes, then at three, and so on up to the normal current, say ten amperes. If the wire covering is in good condition, the resistance of the spool will of course be constant for all currents, or rise slightly, owing to the field becoming warm. But if the spool be "green" from not having been baked, or if it has become soaked with dirty oil, its resistance will be about constant for the weaker currents and will abruptly decrease upon the application of the stronger currents. The writer has measured fields in which this decrease in the resistance of the coil was as much as 20 per cent.

In case of a dry carbonized field the resistance, when hot, will be either less than when cold, or it may remain about the same, or even rise slightly, but in the last case the rise in resistance with heat will be much less than the rise that is caused by the temperature coefficient (0.4 per cent. per degree Centigrade) of the copper.

The writer has had occasion to use the above method on a number of dynamos which showed evidence of weak fields, and it has never failed to correctly indicate the weak spool. Appended is a specimen of one of these tests. The spool was unwound and the wire found to be in very bad condition, the cotton insulation being saturated with oil and colored green with verdigris; there were also large black spots of carbonized and oily wire covering as large as one's hand. Upon rewinding the spool the resistance became constant, as shown in the second table.

ARC DYNAMO NO. —.

TOP LEFT COIL.

Amperes.	Volts.	Ohms.
.50	3.5	7.00
1.00	7.0	7.00
1.50	10.5	7.06
2.80	19.8	7.08
4.00	28.5	7.12
6.05	43.0	7.11
8.05	55.0	6.83
8.15	55.8	6.83
9.70	66.0	6.80
9.80	67.0	6.83

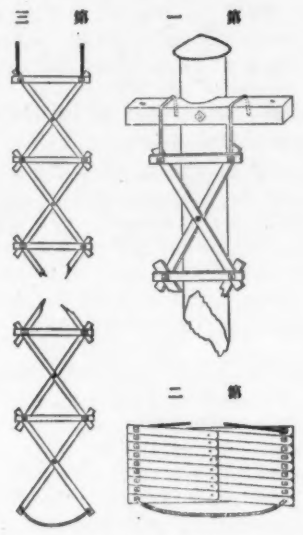
AFTER REWINDING.

Amperes.	Volts.	Ohms.
2.9	20.9	7.20
5.6	40.3	7.20
8.5	61.0	7.18
9.3	67.0	7.20

For the successful use of this method several points are to be noticed. The Western instruments are to be in the best of condition, newly calibrated and working without any sticking of their pointers. The instruments are to be removed a very considerable distance from any magnetic influences that will cause erroneous results. The measurements must be taken when the current is steady, readings taken while the current is varying being of no value. The readings on the meters must be large enough to enable an accuracy of observation of at least 1 per cent. To save the voltmeter from injury, its contact button must always be released before breaking the current in the field.

An Ingenious Japanese Contrivance.

We notice in our Japanese contemporary *The Electrical Friend* for November, an illustration of an ingenious folding ladder for telegraph and telephone poles. We reproduce the illustrations, but regret that we cannot decipher the description, which is in the native hieroglyphics. All we can tell is that the description, but not the illustration, must be read upside down, and that each sentence begins with a huge period as large as the letters. The illustration, however, will explain itself, except in one detail; the short pieces are



Japanese Pole Ladder.

probably pivoted at one end, and can be slipped over or hooked onto a pivot at the other end. The device was designed by Prof. S. Kanda, of the Telegraph School in Tokyo. One objection to it seems to be that its length cannot be adjusted, and as it is doubtless not strong enough to be leaned up against the pole, it must be short enough to hang down straight in all cases, unless the lower segments are detachable.

"Wobbling" the Earth's Charge.

In a letter to the New York *Herald*, and printed in the New Year's number, Nikola Tesla says that, in his opinion, the discovery which would do most to better our condition would be the demonstration that the earth's electrical charge can be disturbed, and thereby electrical waves efficiently transmitted to any distance without the use of cables or wires.

The conveying of motive power from sources such as Niagara in this manner to any place, however remote, would, he says, increase many times the productive capacity of mankind. "It would bring millions of miserable creatures from the darkness of the coal pits to the light of day. It would cause a kinder feeling to spring up between the weak and the strong, which would lead to a generous adjustment of the evermore difficult questions of labor and capital. Even if power could not be distributed, the mere transmission of intelligible signals would be of incalculable benefit. Such a realization would do away with the instability of the financial markets, which is the cause of much suffering and misery. It would greatly facilitate the evolution of novel ideas, as well as the prevention of evils. It would increase the safety of travel, and give a new impetus to the press and spread of knowledge. The first message transmitted would be the signal to general disarmament and a closer union of nations, and the words of the great German poet, 'Seid umschlungen Millionen diesen Kuss der ganzen Welt,' would be deeply felt everywhere."

Mr. Tesla believes that our present knowledge is sufficient to fill us with the conviction that the solution of these important problems is not far off.

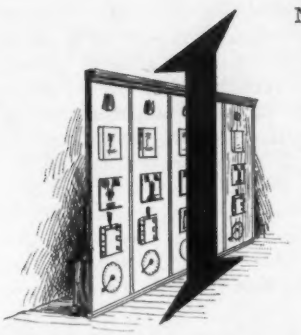
Electricity Direct from Coal.

In reply to a query from the New York *Herald*, as to what discovery or invention would do most to better the conditions of life, Edison answered, "the production of electricity direct from coal."

Central Station Working—II.

ECONOMY OF GENERATION.

BY JAMES B. FOOTE.



IN central station management the burning question is how to improve the service and at the same time decrease expenses. These two much-desired ends seem antagonistic, but there are many cases where some changes can be made that will aid in accomplishing both objects.

The necessity for this increased economy and better service is the result of increasing competition, and the demand by the public for better illumination. The day has gone by when you can let an incandescent lamp burn 5000 hours; time was, when lamp companies advertised the fact that they made a lamp that would burn some such length of time, but we seldom hear of such a thing now. What the public want is light, and when a lamp will not burn out before it gets red and dim, you have got to smash it and put in a new one.

Among the items composing the expense account of a station, the coal bill is probably the largest, and usually offers the best chance for economy. Many stations are equipped with engines that are using from 30 to 40 pounds of steam per I.H.P.-hour, while it is perfectly feasible to obtain engines of very moderate cost that will produce an I.H.P.-hour on 16 to 18 pounds of steam.

The time has gone by when there is any longer a question as to the advisability of using compound engines where water for condensing purposes can be procured; as to whether they shall be triple or two-cylinder compound is, however, a question. The writer has in service two triple-expansion engines, having cylinders of 9½, 14 and 21 inches, and 20 inches stroke, which are run at 185 revolutions per minute, and consume about 18 pounds of steam per I.H.P.-hour, the steam pressure being 140 pounds.

In order to see if there was anything for us in the triple idea, we had another engine built exactly like these except we left out the 14-inch intermediate cylinder; the cylinders were then 9½ and 21 inches and 20 inches stroke, and at the same steam pressure and load gave almost exactly the same results.

These engines are of the plain automatic flat-balanced valve type, and have been in constant use for six and seven years. All the valves are on the governor, which point, the writer thinks, is important in obtaining good regulation. In some makes of engines having a fixed cut-off on the low-pressure cylinder and all the governing done on the high-pressure cylinder, if the load should be suddenly thrown off and the high-pressure valve leak, enough steam would get to the low-pressure cylinder to maintain the vacuum, and with this pulling on the piston the engine would run away.

We have a cross-compound engine which had been in service for eight years, running a steady load of arc lights, and giving good results with a fixed cut-off on the low-pressure valve, but about a year ago we set it to work running electric railway generators, and found at once that it was deficient, both in economy and regulation. We then added a governor to the low-pressure cylinder valve and adjusted it until the work was about divided between the high and low pressure cylinders at all loads, when the speed became more uniform, and less coal was used.

In this connection I might say that when both valves are on the governor, the pressure in the intermediate receiver does not vary nearly so much in pressure with changing loads as when the low pressure has a fixed point of cut-off. This is a specially valuable point, when we have a load fluctuating like that of an electric railway.

The matter of insufficient chimney draught is often responsible for poor economy in boiler work. We have in use a chimney which gave a draught of .25 inches of water, and by applying a 60-inch exhaust-fan, running at 350 revolutions per minute, a draught of .55 inches of water was obtained, which enabled coal to be burned at a higher temperature, caused less soot to be deposited in the tubes, and resulted in a considerable saving of coal.

The furnishing of dry steam to engines is very important. We now put steam separators on all our engines, and the last six boilers installed were made without domes, their place being taken by a steam-separator for each boiler, the water from which was returned through a pipe connected down through the shell and carried below the water line inside the boiler. This arrangement gives perfectly dry steam, and a boiler shell stronger than it would be with a dome.

There was also some trouble before the change to separators, from impurities contained in entrained water cutting the cylinders and valves of the last engine on the steam main but this trouble entirely disappeared.

In carrying pressures of 125 to 150 pounds, great care must be taken in the selection of pipe and fittings. Some of the leading manufacturers are now putting out a line of pipe fittings and valves tested to 600 pounds per square inch; we have one steam and water connections made entirely with this kind, and have not had a single accident, while with the old style of fittings we had two very bad failures, which shut our entire plant down until we could get the boilers shut off.

The question of heating feed water is an important one, both as regards economy of fuel and life of boilers. When no other way can be devised, it is certainly economy to use live steam, as the introduction of cold water into boilers is the cause of many leaky tubes and seams. When compound condensing engines are used, the steam from the low-pressure cylinder as it goes to the condenser can be used, but as this steam only has a temperature of 150 degrees, it does not heat the water as hot as desirable.

We have in use in all our stations an ordinary closed heater, through which we pump to the boilers our feed water. These heaters are supplied with steam from the receiver between the high and low pressure cylinders by a 2-inch pipe; as the only movement of steam in this pipe is to replace that which is condensed in the heater it may be even smaller. The water of condensation is drawn off by a trap. The temperature of feed ordinarily obtained from this heater is from 220 to 230 degrees. The economy of this method over the use of live steam lies in the fact that at least one-half the available work in the steam is used in the high-pressure cylinder. In actual use this heater only reduces the pressure in the receiver from one to two pounds, and has resulted in considerable saving to us over the use of water from the hot well at a temperature of 100 to 110 degrees.

The economy of any engine, other things being equal, depends largely upon the facility with which the valves can be kept tight, which is one reason why the Corliss type of valve have always given such good results, even after long periods of constant use. The flat balanced valve, if furnished with a pressure plate that will follow up the wear of the valve and seat, gives good results for low pressures and small engines, but what some of us are looking for is an engine of say 500 hp, with Corliss valves, compound-condensing, and running at about 160 revolutions per minute; at this speed we can belt direct to the dynamo without the use of pulleys of large diameter on the engine.

In stations where only one kind of current is generated, 500-hp direct-connected units give good results, but where, as in a large number of plants that have to furnish a 24-hour service, for arc, incandescent and power, there must always be three dynamos running at once, it is quite a problem. Some will say, put in monocyclic or two-phase apparatus, and run motors, arcs and incandescents from one dynamo; this is all right for a new plant just about to start in business, but we have, for instance, 75 or 80 motors varying in size from ½ to 25 horse-power, and therefore to make a change means that we must replace these at our own expense.

A good power business in addition to the lighting load is in most cases a money maker, where you have to furnish 24-hour service. Under these conditions we have found the furnishing of power to street railways to pay, and for small roads to be cheaper for the railway company than to furnish it themselves, the amount received per car per day running from $2.25 to $2.50 for 8 to 15 cars.

The use of a line shaft is to be avoided whenever possible. We had one station equipped with a jack-shaft put up in good shape, with self-oiling bearings, quill-drive clutch couplings, etc., the shaft being about 50 feet long, and run at 370 revolutions per minute. It was found to take considerable power, and it was finally decided to belt the dynamos direct to the engines. As one of the engines had only one pulley, we had to put the belts for the four dynamos on one above the other, making them four deep on the driving pulley. The dynamos were three 50-light arc machines and one 1500-light alternator, and by this arrangement we saved enough power to run 50 arc lights, besides reducing wear and tear and attendance.

Every station manager should know each day the output in watts of each kind of current which he supplies, and also the amount of coal used. For power, street railway service and alternating incandescents, recording wattmeters can be used to advantage. For arc circuits the writer uses a Weston voltmeter reading to 3000 volts and connected to a special switch, designed by himself, which, by rotating a handle, successively connects the voltmeter to all the circuits on the board. The dynamo man takes readings of the voltage at stated intervals and records them upon blanks provided for the purpose, and also records the time of putting on and shutting down each circuit, together with any interruptions which may occur.

This method has two advantages: First, it indicates the polarity of the circuit, and if any one of them becomes reversed, will tell it when the next reading is taken; and second, it indicates the condition of lamps and circuits. In looking over the report you can detect a flashing dynamo as readily as if you stood in the station; or, if, as was once the case with us, you get a bad lot of carbons, the readings will be higher than usual; or if your lamp repairer is not adjusting his lamps at the proper voltages, you can soon find him out, for your circuit will begin to take more voltage than it should.

If a record of watt-hours per pounds of coal generated each day and also total watt-hours and coal consumed were made, it would form a very convenient reference to compare your present with past performance. For if you are burning more coal this year than last, your engineer will usually, if you ask him the reason, tell you what an awful increase there has been in the load, which may be true or not, according to circumstances; but if you have the record before you it will enable you to detect any leaks that may have developed, and give you a chance to remedy them.

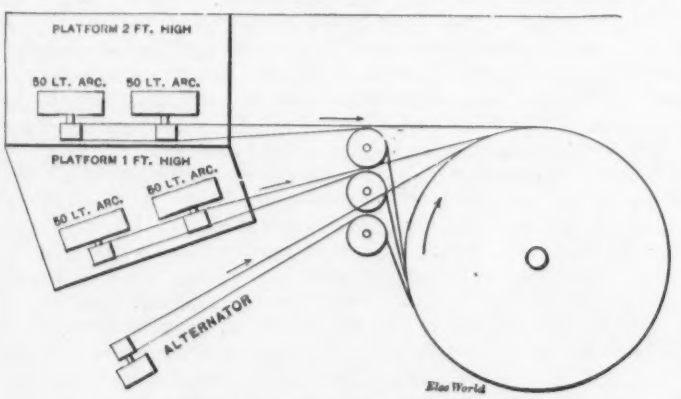
If some one would put on the market a first-class alternating-current station voltmeter, one that would be independent of changes in the frequency of the current, and as reliable as the best continuous current instrument, it would fill a long-felt want. I have run quite a good many small alternating-current plants where the voltmeter in use was the one sent by the maker of the dynamo, and supposed by the man in charge to be correct, but which, upon applying a standard portable instrument, would be found to be from one to five volts out of the way. This trouble might not occur if the dynamos were run at the exact speed for which they were built, but this is practically hardly ever possible.

The subject of circuit breakers versus fuses is one that is attracting considerable attention just now. In the light of my experience with fuse-wires, it seems to me that a fuse of over 15 or 20 amperes capacity is of no earthly account, as the amount of metal in a large fuse requires some time to heat up, and the belt of your dynamo may be wound upon your engine shaft long before an able-bodied fuse makes up its mind to blow. I have repeatedly seen a 100-ampere fuse stand 200 or more amperes of sudden load without blowing, and then an hour or so after melt on 80 or 90 amperes of steady load; such performances make you tired, and create a desire for something better. There can be no doubt about the advisability of equipping alternating as well as direct current dynamos with automatic circuit breakers, as they will surely save both money and annoyance.

We have in operation a small water-power plant which is rather unique, and a brief description of it may be of interest to some of the readers of this paper.

This plant consists, when fully equipped, of a 74-inch Leffel-Sampson turbine water-wheel, working under a head of about 12 feet, and running, at 66 revolutions per minute, four 50-light arc dynamos and one 600-light alternator. The accompanying illustration will serve to show the arrangement of dynamos and belts.

The drive pulley, which is 18 feet in diameter, is made of hard maple, and weighs about 4000 pounds; it has three belt faces, two



Method of Belting Generators.

being 12 inches, and one 14 inches wide, and is placed horizontally on the end of the turbine shaft. The belts are carried from this pulley to the dynamo pulley and given a one-quarter turn; from the dynamo pulley they are returned to the idlers shown, around which the slack side of the belt is carried to the drive pulley again. Two-arc dynamos are run from each 12-inch belt face, one over the other, the dynamos being tandem upon the same foundation, while the alternator is run from the 14-inch belt face. The two-arc dynamos run from the upper belt face are placed upon a substantial platform two feet from the floor, while the two belting from the middle belt face are on a platform one foot from the floor, the alternator being upon the floor itself. This makes a very simple arrangement, and eliminates the loss of power as well as trouble always present when gears and a line shaft are used.

The writer had one experience connected with this plant which may be worth recording. The belts running over the wood driving pulley had no chance to discharge themselves of the static current which they generated; as they were entirely insulated from the ground they would become very highly charged, but gave no serious trouble until the first cold snap this Fall, with a very dry atmosphere, when the alternator became so charged that the current jumped from the field poles to the armature conductors, making two punctures on exactly opposite sides of the armature. The dynamo current following the static discharge made some brilliant fireworks for a few seconds; the men in charge shut down and put in a new armature, which was no sooner started than the same experience was repeated. Upon my arrival upon the scene I determined what the matter was, and to test it dropped a wire through the floor into the water below and connected it to the dynamo frame; upon starting up no further trouble was experienced, the dynamo being entirely free from any static charge.

This static discharge may be the reason for many armature and field burn-outs for which no cause could be assigned, but it is easily gotten rid of by presenting to the face of the belt a sufficient number of discharging points.

One of the most convenient appliances in a station where there is no traveling crane, is a small portable crane, made by taking a six-inch I-beam about 12 feet long and supporting it with four hard-wood legs about 10 feet long, well braced and fastened to the I-beam by boiler-iron plates; upon the I-beam a small trevele- is placed, to which a pair of one and one half-ton chain blocks are attached. Such a crane can be moved about the station by two men, and any part of a dynamo weighing not more than 3000 pounds can be handled with the greatest ease.

There is a large number of small alternating-current plants in this country that are loaded down with a large transformer load. The stations have grown up on the plan of putting a transformer to each consumer, and with the result that they have to carry through the greater part of the run a dead load of 20 or 30 per cent. of the maximum load on the station.

The writer remembers that when once visiting a small town the first thing he saw, when he got into the main business street, was a pole with 7 five- and ten-light transformers on it, all connected to one primary circuit; and as he went down the street he saw many more instances nearly as bad. Such work is altogether too common, and is one of the reasons why such stations do not pay.

One of the plants with which the writer is connected was built a number of years ago when we did not know as much as we do now about such things, and is something after the order of the one described above, though not so bad. This station has a transformer capacity of about 3000 to 4000 lights, mostly made up of five, ten and twenty-five light transformers; the lighting from this station is furnished almost entirely by meter, there being about 400 meters connected, and on the brightest day, when nearly all the lights are off, there will be a transformer load of 30,000 watts, as measured by a Thomson recording wattmeter.

With this kind of an arrangement it is pretty hard to make residence lighting pay, but we have another plant, however, which is arranged upon an improved plan. At this plant are used mostly 15-kw transformers, the primary voltage being about 2300, and the secondary mains are run on the three-wire system, 116 volts on each side of the neutral wire; by this system we serve a residence district, having a radius of 1500 or 1800 feet, with a transformer at the centre.

To these mains can be connected lamps to many times the capacity of the transformer, as residences are usually wired up for from 25 to 75 lights, and the average use will be above five to ten lamps; at the same time, if in any of them every lamp in the house is lighted, the converter capacity is there, and as no two houses will want all their lamps the same night, a little excess capacity in one large transformer will answer for the whole district served by it. All large houses are wired up on the three-wire system clear through, but small ones are placed alternately on opposite sides of the neutral wire.

The commercial lighting is done on the same plan as the residence lighting, except that in the business district we do not have to wire so far to get enough lights to load a 15-kw transformer. This station, with a capacity of about 5000 lights, will, when all lights are off, show a transformer loss of about 10,000 watts, as measured by a Thomson wattmeter, which is a big difference in favor of the large transformers.

While on the subject of converters, I would like to say that the use of rubber bushings where the wires enter the transformers and fuse boxes is, in the light of my experience, highly objectionable, particu-

larly when 2000 volts pressure is used; in fact, the only trouble we ever had with our 2000-volt apparatus has come from the burning out of rubber bushings in transformers and fuse boxes, and we have been compelled to substitute porcelain for the rubber in every case.

There seems to be quite a tendency among alternating stations to change from 50 to 100 volt lamps, and we are doing something along this line whenever we can get several old customers in one locality bunched together on one transformer instead of two or three. This of course involves a change in meters, but we found that the Thomson 50-volt meters could be made into 100-volt by winding a wire resistance coil in series with the armature. We purchased a Weston wattmeter to calibrate them by, and went at it with very good success. If the 50-volt meter had a constant of one half, when changed to 100-volt, it would have become unity; or, if at 50 volts it were unity, at 100 it would have a constant of two.

When the alternating system was first introduced lamp manufacturers made a better 50-volt than 100-volt lamp, and this, together with other supposed advantages, led to the general adoption of the former. At the present time, however, as good a 100-volt lamp can be had as can be made at any voltage, and there seems to be no reason for continuing to tie ourselves down to short runs and small transformers by the use of 50-volt lamps.

Centralization of Transmitter Batteries in Telephone Exchanges.

BY KEMPSTER B. MILLER.

The idea of centrally generating electric energy and distributing it to the consumers over wide areas is finding more and more favor in nearly all branches of engineering.

Telephone engineers long ago appreciated this fact, and probably no one line tending toward the practical advancement of telephone exchange service has received greater attention by inventors and designers during the past few years than the removal of transmitter batteries from the subscribers' stations and substituting for them a centrally located source of current.

The advantages to be derived when such a centralization can be successfully achieved are manifestly great. The electrical efficiency of the plant will be much increased by having one large unit of energy in operation practically all the time instead of a multitude of small units each in use only a few minutes per day. The amount of idle capital represented by the local batteries will be rendered *nil;* the labor of visiting the subscribers' stations to repair and replenish the batteries will be done away with; the subscribers' telephone sets will be made neater and more compact; and, finally, there will be no freezing of the locals.

Where no induction coil is used the problem becomes very simple, the battery then being placed directly in the line with the transmitter and receiver; and it obviously makes no difference in what part of the circuit it is so placed. In fact, in 1881 George L. Anders invented a system in which the transmitter batteries were placed in the loop used to connect two lines at the central office. He substituted for the Edison or Blake transmitter the then new Hunnings granular type, thereby permitting the use of a somewhat heavier battery and rendering the efficiency of transmission correspondingly greater. As is well known, however, the induction coil is too great a factor toward good results to be put aside for the advantages derived from the centrally located battery.

Where the transmitter is directly in the circuit of a long line the latter may have a resistance of several thousand ohms, while the former can produce a change of resistance of only a few ohms. This change, due to the operation of the transmitter, will therefore be very small in comparison with the total resistance of the line, and the corresponding changes in current will likewise be very small.

To illustrate: Take a line having a resistance of 500 ohms, and suppose the transmitter capable of producing therein changes of one ohm. Such changes will therefore be but one five-hundredth of the total resistance, and the resulting change in the current flowing on the line will be but one five-hundredth of its normal value. On the other hand, suppose the microphone and battery to be in a local circuit with the primary of an induction coil, and that this circuit has a resistance of 10 ohms. A change in the resistance of the transmitter of one ohm will therefore change the resistance of the local circuit one tenth its value, with a corresponding change of one tenth of the value of the current. Thus it is seen that any method dispensing with the local battery, which at the same time renders the induction coil unavailable, is not in line with increased efficiency of transmission, and can be tolerated only in systems having very short lines.

Charles E. Scribner, perhaps the most prolific American inventor of telephone systems, was the first to devise an exchange combining the advantages of the induction coil with those afforded by the centralized current supply. This he did in 1881. In addition to the regular talking lines of an ordinary exchange, he ran a supply wire, *S* (see Fig. 1), from a large battery, *B*, at the central office, serially through all the subscribers' stations. At each of such stations the supply wire passes through a Wheatstone bridge, in one branch of which is the microphone *M*, and in the other three the balancing resistances r^1, r^2, r^3 respectively. In the bridge wire is connected the primary helix *p* of the induction coil, of which the secondary helix *s* is connected in the talking circuit *L* with the receiver *R*. These talking circuits *L* of course run to the central-office switchboard (not shown), and may there be connected up in pairs for conversation in the usual manner. The resistances r^1, r^2, r^3 are so adjusted to each other and to the resistance of the microphone, when at rest, that no current normally flows through the bridge wire and primary helix *p*. When, however, the resistance of the microphone is caused to change by sound waves striking against the diaphragm, the balance of the bridge is destroyed, and currents corresponding to such changes in resistance are caused to flow through the primary helix. These currents induce others in the secondary *s* of the talking circuit, and thus affect the receivers in the ordinary manner.

Among other methods in which a separate supply wire is used is one devised by Mr. John S. Stone, of Boston. Like Scribner's system, the supply wire is entirely independent of the ordinary talking circuits of the exchange, being only inductively related thereto. A suitable direct-current dynamo, *D* (see Fig. 3), is connected in the

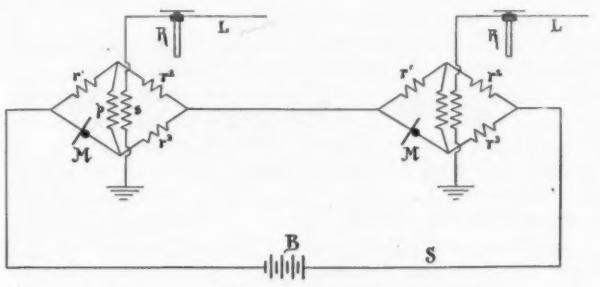


FIG. 1.—SCRIBNER SYSTEM.

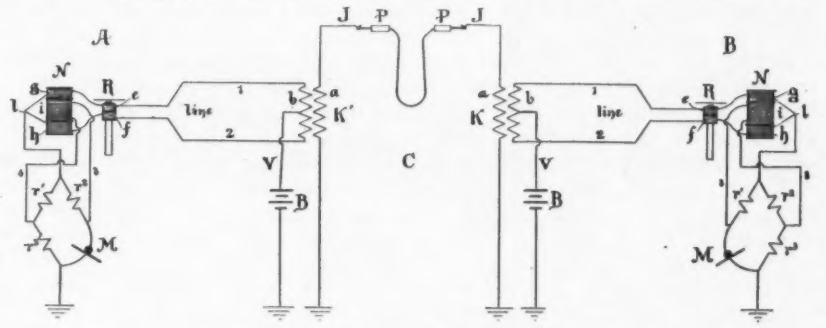


FIG. 2.—CARTY SYSTEM.

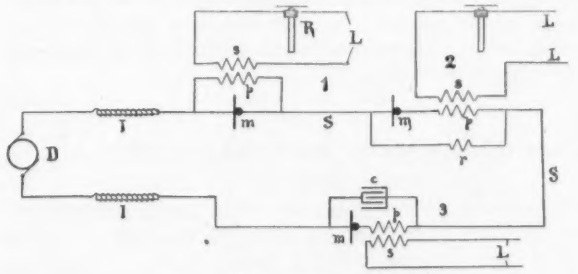


FIG. 3.—STONE SYSTEM.

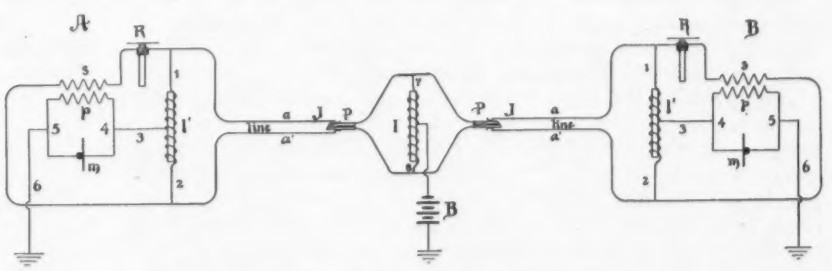


FIG. 4.—DEAN SYSTEM.

supply circuit in which are included the microphones *m* of the various stations. Included also in the circuit between the dynamo and the first microphone, on each side thereof, are the retardation coils *I I*, the purposes of which are to smooth out irregularities in the dynamo current and to prevent the changes in the current due to the actuation of the microphones from affecting the supply circuit as a whole. In this figure three distinct arrangements of microphone circuits are shown at subscribers' stations 1, 2 and 3 respectively. At one an increase in the resistance of the microphone *m* will cause more current to flow through its shunt wire containing the primary helix *p* of the induction coil. Likewise a decrease in the microphone resistance causes a corresponding decrease in the current through the shunt circuit and primary. Currents corresponding to these fluctuations are induced in the secondary helix *s* which is directly in the line wire of that station.

At station 2 the primary of the induction coil is in the supply wire with the microphone, while a shunt around both contains a non-inductive resistance *r*. Station 3 differs from 2 only in that a condenser *c* replaces the non-inductive resistance *r*. In this case the condenser forms a barrier to the steady currents from the dynamo, but allows fluctuations in the current, due to the variation in the microphone resistance, to pass readily. In all three cases these fluctuations are practically confined to the local circuit formed by the microphone and its shunt wire, the current in the supply line, as a whole, being kept free from any rapid alteration by the high impedance coils *R R*. This system was especially designed for supplying current to the operators' microphones at large central stations, but is, of course, equally applicable to subscribers' stations.

While doing away with the local batteries and their consequent disadvantages, both systems so far described have one vital defect,—namely, that a supply wire must be run to each station in addition to the regular line wires. The cost of this extra wire cannot be materially less than that of the local batteries, and a break-down on it disables not one station alone, but all the stations to which it runs.

In 1889 John J. Carty designed an exchange embracing the advantages of the central-supply system, but avoiding this objectionable adjunct, the extra supply wire. This system is shown in Fig. 2. *A* and *B* are two subscribers' stations, and *C* is the central office switchboard with its line spring-jacks *J* and connecting plugs *P P*. *K K'* are repeating coils, also at the central office, each having its two helices *a* and *b* equal in resistance and in number of turns. The helix *a* of each of these repeating coils has one of its terminals grounded, and the other connected to the spring-jack *J* of its particular line. The two ends of the other helix *b* are connected respectively to the line wires 1 and 2, while its central point is grounded through the wire *V* containing the supply battery *B*. (For convenience of illustration two batteries, *B*, are shown, but in practice the central points of all the helices, *b*, would be connected to the same battery.) The line wires 1 and 2 pass respectively through the equal helices *e* and *f* of the receiver *R*, and the two equal secondary helices *g* and *h* of the induction coil *N*, after which they unite at the point *l*, and pass to ground through a Wheatstone bridge, of which the transmitter *M* forms one branch, as is clearly shown. The primary helix *i* of the induction coil is placed in the bridge wire 3, as is the case in the Scribner system previously described.

It is now evident that the supply current from battery *B* finds circuit over wire *V* to the centre of the helix *b* of the repeating coil *K*, where it divides and passes over the two branches 1 and 2 of the line in parallel, and through the separate helices *e*, *f*, of the receiver *R* and *g*, *h* of the induction coil *N* to the point *l*, where it reunites and passes to ground through the balanced resistances of the Wheatstone bridge. As the pairs of helices *e*, *f* and *g*, *h* are each differentially wound with respect to currents passing over the two branches of the line in parallel, this current from battery *B* produces no magnetic effect in their cores. The two stations *A* and *B* are shown connected together at central through the medium of the pair of plugs *P P* and their connecting cord. Suppose now the subscriber at *B* to be talking to his microphone *M*. The variations thus caused in the resistance of the branch containing the microphone destroys the balance of the bridge, and corresponding undulatory currents are caused to flow through the bridge wire 3 containing the primary helix *i* of the induction coil *N* and at station *B*. These induce similar alternating currents in the secondary helices *g*, *h*, which currents circulate in the metallic circuit formed by the line wires 1, 2. This circuit may be traced from point *l*, helices *g* and *e*, line 1, helix *b*, line 2, helices *f* and *h*, and back to point *l*. These currents are reproduced in the plug circuit at central by means of the helices *b* and *a* of the repeating coil *K*, and are again reproduced in the metallic circuit of lines 1 and 2 of station *A* by virtue of the repeating coil K^1. It will be noticed that these "voice currents" pass in opposite directions through the helices *e* and *f* of the receivers in both stations, and their effect is therefore cumulative rather than differential, thus affecting the receivers.

In Fig. 4 is shown a system devised in 1894 by William W. Dean, of St. Louis, Mo. This represents one of the latest developments, and, as will be seen, is somewhat similar to the Carty system, though it possesses advantages thereover, not the least of which is the dispensing with the repeating coils at central, and the simplification of the subscribers' station apparatus.

The figure shows two subscribers' stations, *A* and *B*, connected together at the central station by means of the pair of plugs *P*, *P*. *B* is the transmitter supply battery, and when two lines have been thus connected up the supply circuit may be traced to each station as follows: From ground at central through battery *B* to the centre of the impedance coil *I*, where it divides and passes through the two halves of this coil, through the two limbs *a a'* of the line to the subscribers' stations, thence through the two wires 1, 2 to the centre of the impedance coil *I'*, thence by wire 3 to the point 4, where it again divides, one part passing through the primary, *p* of the induction coil and the other through the microphone *m*. These currents reunite at point 5 and pass by wire 6 to ground. The operation is easily understood. Variations in the resistance of the transmitter *m* cause more or less of the supply current to be shunted through the primary *p* of the induction coil, which variations induce corresponding currents in the secondary *s*, placed directly in the line circuit with the telephone receiver *R*. These currents flow over the metallic circuit formed by the two connected lines, and are prevented from flowing through the bridge wires 1 and 2 and 7 and 8 by the retardation coils *I*, *I'* included therein.

It will be noticed that in all the four systems described the benefits of the induction coil are fully realized. The changes in current in the primaries of the induction coils depend entirely upon the resistances of the local or transmitter circuit in which they are placed, and upon the power of such transmitters; and are entirely independent of the length or resistance of the lines.

An article on this subject would be incomplete without mention of an entirely distinct method of centralizing the generation of transmitter current, the perfecting of which is now seriously occupying the minds of many leading telephonists. This is the use of a storage battery at each subscribers' station, charged, while the line is not in use, from a generator at central. When, however, the line is switched for conversation the central generator is automatically cut off and the storage battery switched into a local circuit with the subscriber's transmitter and primary coil, to be used in precisely the same manner as the now almost universal local primary battery. It is said that this storage battery requires practically no attention, but a greater and, in fact, its chief advantage is that it permits the use of a local circuit of extremely low resistance, the resistance of the storage battery being almost negligible.

Charles E. Buell, in 1881, was the pioneer in this line, followed by Stearns in 1883; Dyer in 1888, and Dean and others in 1894 and 1895.

The exchanges described are only a few of the many devised in the last few years, and are here illustrated not because they are necessarily better than others, but because they seem to be typical examples and to clearly represent the development of the art. The diagrams and descriptions have been stripped of all confusing details, such as calling and clearing out apparatus, switches, and operators' telephone sets, it having been my purpose to illustrate as simply as possible the principles involved.

An Electric Elevator One and a Half Miles High.

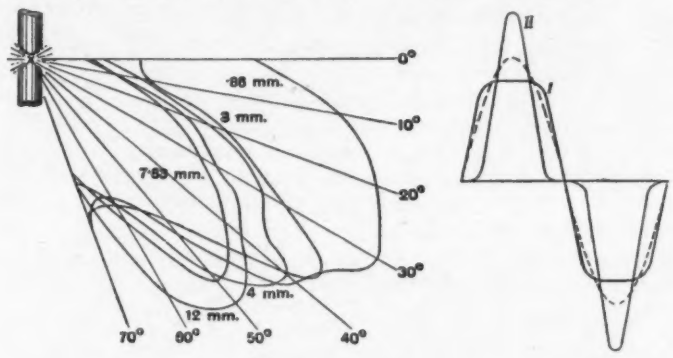
The projected electric railway to the top of the Jungfrau seems to have encouraged engineers to try other and still more difficult problems. It appears that a French mining engineer is making plans for an electric elevator to the top of Mt. Blanc; a horizontal tunnel is to be bored, and from there to the top the ascent is to be made by electric elevators in a vertical shaft one and a half miles high. It is questionable whether it is practicable to bore such a vertical shaft, as the work must evidently be carried on from below upwards. It is thought that the time for the ascent will be 30 minutes. The plan adopted for the Jungfrau has the great advantage over the other, that the ascent itself will be one of the most attractive features; for the projected Mt. Blanc elevator there will be absolutely nothing of interest until the top is reached. To get to the top by any other means than by a shaft or tunnel seems out of the question, as the top for miles around is all a mass of snow and moving glaciers on which no permanent structure could be built.

Researches on Alternate-Current Arcs.*

BY H. GÖRGES.

These investigations were carried on during a number of years at the Charlottenburg works of Messrs. Siemens & Halske. They were conducted by Messrs. Oelschläger, Greisser and Dr. Michalke.

It is well known that with a continuous current the positive carbon assumes a much higher temperature and greater luminosity than the negative carbon. With an alternate current the upper and lower carbons are positive in turn, and the stronger light is alternately thrown upward and downward. The limit of perception of the flickering differs subjectively and lies at about 60 periods per second. At 40 per second it is still unendurable, at 50 it is barely perceptible. It is less seen when the arc is surrounded by a ground glass globe and when the lamp is at a greater distance. A reflector of the Helios pattern, placed close above the arc, reduces the flickering considerably by reflecting the impulses of the lower carbon and sending 100 light-impulses to the eye instead of 50. The length of the arc largely influences the luminosity with the same expenditure of energy. It is evident that each carbon takes away much of the light by creating its own shadow. Hence the arc should not be made too small. On the other hand, the temperature of the ends is highest when they are as close together as possible. Fig. 1 shows how the brightness decreases with an increasing length of arc, the energy remaining the same. The curves represent the light per watt for a 12-ampere lamp; 1 mm



FIGS. 1 AND 2.

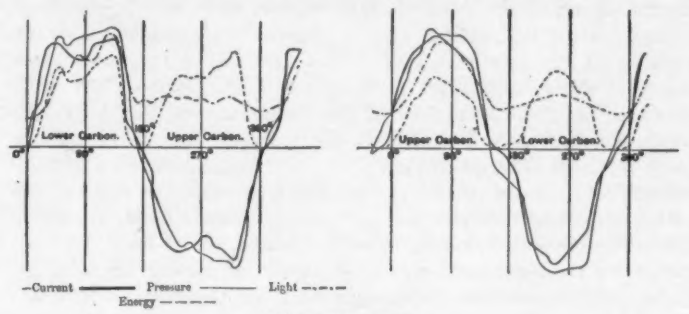
represents ¼ Hefner candle. The numbers at the side of the curves represent the length of arc. The shape of the current curve has also a great influence upon the character and behavior of the arc. With some machines the curve may be altered by simply changing the connections. For the following experiments one of Siemens & Halske's "drehstrom" machines was used, which could be connected at will in triangle or in star. Taking one branch only, a flat curve was obtained (Fig. 2, I). On connecting in star, the superposition of the curves due to both branches produced a new curve somewhat resembling the sinusoidal curve (Fig. 2, broken curve). Finally, on connecting the two branches in series in the opposite direction to the connection in star, a pointed curve is obtained (Fig. 2, II), which is not adapted for practical use since the output of the machine is too small.

The noise made by the arc depends greatly upon the current curve. By the periodic heating and expansion of the carbon points and of the air between them, notes and noises are produced. They always occur in the alternate-current arc. With a sinusoidal curve the note is soft and musically pure; with suddenly varying curves, overtones and impure noises appear, which are perceived as a more or less loud humming. This becomes louder as the length of arc, the number of alternations and the current increase. With a greatly extended arc it sounds almost like a trumpet. The noise is much diminished by glass shades, and becomes almost imperceptible in the case of sinusoidal currents.

The temperature of the carbon points, and hence also the luminosity, is essentially determined by the energy consumed in the arc. With high frequencies the amount of light is probably independent of the form of the curve. But with the frequencies actually employed the luminosity, as has been shown in detail by Prof. Wedding and Dr. Rössler, increases with the flatness of the curves. Our own measurements bear out this result. We found for a 12-ampere lamp, with a frequency of 50 per second, for a flat and a pointed curve, the data given in the accompanying table.

*Abstract of address delivered before the Elektrotechnische Verein. Reprinted from the London *Electrician*.

The higher efficiency of the flatter curves may be accounted for in two ways. With pointed curves a short period of a large current is followed by a longer time of small current. During the latter period the carbons will cool considerably. But with decreasing temperature the luminous radiation also rapidly diminishes. The intervals of small current will therefore have little influence on the



FIGS. 3 AND 4.

luminous output. But quite a different explanation may be given. The eye perceives a mean luminous intensity when the frequency is high enough. If we imagine the light curves really traced in a system of co-ordinates, the mean algebraic value may be the same for flat and pointed curves. But perhaps the eye measures another mean value, just as the dynamometer does not measure the algebraic mean of the current intensity.

TABLE OF EXPERIMENTAL DATA.

	Flat curve.	Pointed curve.
Mean pressure	33.5 volts.	25.7 volts.
Maximum for 1 volt mean pressure	1.19 "	1.93 "
Maximum for 33.5 volts mean pressure	40. "	....
Maximum for 25.7 volts mean pressure	....	49.2 "
Displacement of phase between current and lamp pressure	19 deg.	19 deg.
Mean length of arc	2.9 mm.	3.1 mm.
Mean spherical intensity per watt	0.960 Hefner units.	0.796 Hefner units.

To obtain an objective record of these luminosities, a disc covered with sensitive paper was attached to a motor, and covered with a stationary disc, provided with a radial slit. The result was a photographic tracing of the variations of luminosity during each revolution of the shaft. It was found that the sensitive paper is capable of recording as many as 300 alternations of light per second, where the eye sees nothing but a steady glow. Several of the traces thus obtained are reproduced in the paper.

By a somewhat similar arrangement the experimenters were also able to apply the photometer direct to the light caught intermittently at a certain phase, and to determine the curves of current and pressure at the same time. The results of these measurements

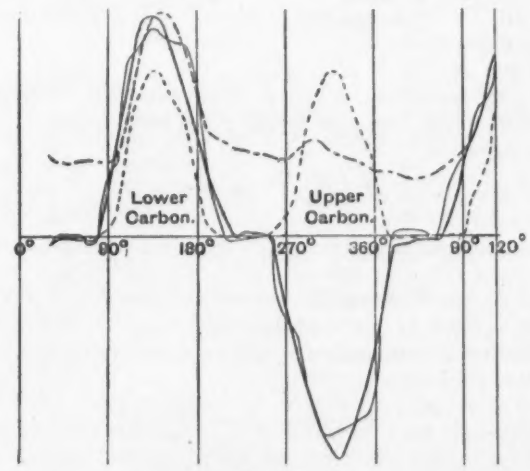


FIG. 5.

are shown in Figs. 3, 4 and 5. The rays measured are those projected at an angle of 35 degrees below the horizontal. During the period of large current an accumulation of heat takes place, which is expressed by an increase of temperature and light. This is especially seen in the flat curve (Fig. 3), but not in the pointed curve, as the current falls too rapidly. As regards the displacement of phase between volts and current, it is decidedly positive near

the zero line, *i. e.*, like that produced by self-induction. It is also seen that when the current has a high value the current suffers a negative displacement. The curves of current and light in Fig. 3 are decidedly pushed to the left with reference to the pressure. This is easily explained on the assumption of a thermoelectric counter E. M. F. in the arc. We assume that at each carbon point there is a thermoelectric force between the carbon and the atmosphere directed toward the carbon. Since the two minima are approximately equal, the thermoelectric forces must also be approximately equal, and must neutralize each other. Hence the slight self-inductance in the mechanism of the lamp and in the carbons is brought into play, and displaces the current curve toward the right. At times of large current there is a great difference of temperature between the carbon points; the thermoelectric force at the positive carbon is in excess, and produces a counter E. M. F., which reduces the current. Owing to the accumulation of heat the temperature on the right-hand side of the crest of the current must be highest, and must reduce the current more on this than on the left side. Hence the crest looks as if pressed toward the left. A similar effect may be noticed in the other curves.

The Effective Centre of Light from a Standard Photometric Burner.

BY CLAYTON H. SHARP, PH. D.

In an article which was read before the American Society of Mechanical Engineers, and which was given in abstract in The Electrical World of Dec. 14, 1895, Mr. D. S. Jacobus describes an experimental determination of the effective centre of light for a London Argand burner having a wide, horizontal slit. This problem is precisely similar to that of finding the effective centre of light for the Vernon-Harcourt pentane lamp. The theory of this form of light standard is extremely simple, and since it does not seem to be very generally known, it may be given here.*

Let I be the intensity of the source and i be the intensity of unit height of flame considered as a uniform cylinder. Let H be the height of slit, $B\,C$, in figure, and $D\,H = D\,d + E\,e$, the increase of height due to parallax.

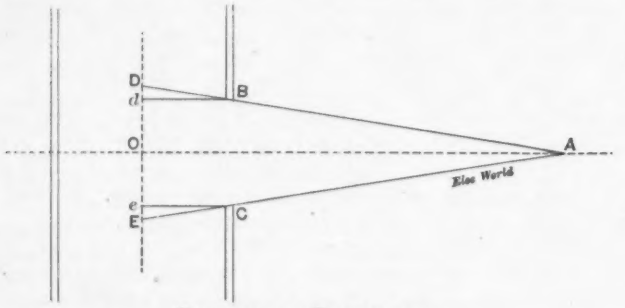


Diagram of Photometer.

Then $I = i\,H + i\,D\,H$.

If $R = r$ represent the distance from the flame axis to the photometer disc and to the edges of the slit, respectively, we have from similar triangles,

$$\frac{R}{r} = \frac{H + D\,H}{D\,H} \text{ and } D\,H = H\,\frac{r}{R-r}$$

$$\text{Then } I = i\,H\left(1 + \frac{r}{R-r}\right) = I^1\,\frac{R}{r-R}\,\dagger$$

In which $I^1 = i\,H$, being the intensity of the source due only to the portion of flame having the height H.

Thein tensity of illumination on the photometer disc will be

$$I^1\frac{\frac{R}{R-r}}{R^2} = I^1\frac{1}{R\,(R-r)} = \frac{I^1}{\left(R-\frac{r}{2}\right)^2}$$

approximately, since R is much greater than r.

Hence the effective centre of the source is at a distance equal to half of the radius of the screen in front of the axis of the flame.

In Mr. Jacobus' experiments r was equal to 1⅞ inches, and the effective light centre was found to be ⅞ inch from the axis of the flame. These two quantities stand to each other in the ratio of ½—a close approximation to the value indicated by the theory.

The errors arising in certain cases, from a failure to make a proper setting of a standard, having a screen of this sort, are much larger than one at a first thought would expect, and serve strongly to emphasize the necessity of using great care and forethought in making even the simplest photometric measurements.

That an error of a similar kind may occur in the use of standard candles has been illustrated in a striking manner by an experiment made by Mr. Wm. Sugg.

The axis of the flame of an English standard candle is not, in general, the prolongation of the axis of the candle itself, but lies at one side of this axis, in a position which depends on the size of the flame, and on the curvature or curl of the upper part of the wick. As the wick burns down, exposing fresh parts to the heat, it will twist about, carrying with it the axis of the flame. Thus the position of the light centre in respect to the photometer bar may be materially changed.

Mr. Sugg ‡ took a series of photographs of the flame of a candle which had been adjusted so that the flame-axis coincided with the prolongation of the axis of the candle. These photographs show how in the course of a little time the wick twisted far enough to notch the flame of the curl of the wick through 90 degrees, bringing the axis of the flame a noticeable distance nearer the photometer bar.

It is to be noted that errors of this sort are minimized by the use of a *long* photometer bar. On a bar 200 inches long they become, in general, comparatively insignificant. Such a bar presents this additional advantage; the error arising from the considerable size of the luminous source as compared with the distance between the source and the photometer disc is decreased, while the coarser divisions render it possible to take readings of photometer settings with great quickness and facility. The diminution of the intensity of illumination on the photometer disc involved in the use of a longer bar is not of practical importance when dealing with the comparatively powerful light sources used to-day.

*See Liebenthal, *Electrotechnische Zeitschrift* for October, 1895.

†Or, since intensities are proportional to the amount of flame exposed, we see at once that

$$\frac{I}{I^1} = \frac{D\,E}{B\,C} = \frac{R}{R-r}.$$

Storage Batteries.

In the current number of the *Transactions* of the American Institute of Electrical Engineers is printed the oral discussions at the November meeting of the Institute on "Storage-Battery Applications," from which we extract the following remarks by Messrs. Edgar and Entz.

In regard to the question of cost, Mr. C. L. Edgar, of the Boston Edison Illuminating station said that in the old type of station it was usually customary to figure that the entire steam plant outside of the real estate and buildings—by steam plant meaning the generating plant in general—cost from $50 to $60 a horse-power. With the new type, high economy plant, it costs from $90 to $100 a horse-power. In the Boston station this was found to be almost exactly true. In regard to batteries, the first battery was put in to give 1650 amperes on each side of the system. A 650-hp generating set gives out 1333 amperes on each side. This, as a steam plant, would have cost $65,000. The contract was for $44,000, and there were enough incidentals probably to bring it up to $50,000. This included 45 per cent. duty, but this does not imply that the battery in this country would cost 45 per cent. less, as the cost of crude lead here is so much more, that part of it is eaten up irrespective of the question of duty. The second battery was double the size. That capacity would cost $130,000 if it had been a generating plant. The contract was $64,000 for the battery. The former price included the switchboard, the latter did not; to that is added $25,000 to include switchboard and everything outside of the building. So that about $90,000 as compared with $130,000, and $50,000 as compared with $65,000 is the comparison. Mr. Edgar emphasized the fact that in this comparison kilowatt-hours are secondary. Kilowatt-hours have to do with operating. Kilowatt maximum has to do with investment, and the Boston plant was put in for investment purposes. That is to say, with the same amount of capital more apparatus can be put in by using storage batteries than without. Now, if such apparatus have a capacity large enough to do that work which actually exists, enough money is actually saved by equipping one third of stations with battery and two thirds with steam. This does not imply that, considering the question of kw-hours in general, for traction purposes, or for all the incidental purposes, that batteries are of course not very much more expensive than steam plants, and this statement is made with particular reference to that special use of the battery.

‡W. Sugg. *Journal for Gas Lighting*; Sci. Am. Sup., No. 484, p. 7726.

In regard to efficiency, the guaranteed efficiency is 75 per cent. and Mr. Edgar has never understood that a high rate of charge and discharge was going to interfere with the efficiency of the battery. It is undoubtedly going to cut down the capacity. With an hour-and-a-half rate of discharge, the battery has only two thirds of the capacity that it has at four, five and six hours discharge. The efficiency is the same, and we feel quite sure that the manufacturers claimed that the higher efficiency could be obtained if charged and discharged at maximum rates than otherwise.

There is another point, Mr. Edgar said, that Dr. Crocker made, which appealed to him in exactly the opposite way from what it did to Prof. Crocker, that is, the English practice of running a large number of small engines as compared with the German practice of using two or three very large ones. It was that particular thing that appealed to him for the value of the storage battery. When we realize that with the same type of engine, if you put in a 200-hp engine and one of 800 hp, you naturally get 10 per cent. better efficiency out of the large one, from the nature of its construction, and that the small engine is likely to run 15 to 18 hours a day; you will find that the inefficiency caused by the small engine is very much greater than the 25 per cent. battery inefficiently run for only two hours a day. So that the actual economy of these small engines running under the best possible conditions is less than the economy of the large engines run under the best possible conditions, and a storage battery of 75 per cent efficiency.

In regard also to the question of guarantee, the guarantee for the Boston battery was 6 per cent. of the cost of the cells. On the $44,000 contract the cells were put in at about $29,000. In the $64,000 contract the cells were put in at $59,000, so that 6 per cent. is being paid on $5900 worth of investment. There was a clause in the contract that if any American company was established, this should be reduced to 4 per cent., because this was done in Germany. Manufacturers abroad were always willing to give a guarantee of 4 per cent., but that at least 75 per cent. of their customers refused it on the ground that it cost them but three.

The Boston battery rated at 1600 amperes has not a less factor of safety than an engine with one quarter cut-off; that is to say, that the battery is supposed to run regularly 1600 amperes, and the engines that were put in at that cost are supposed to run regularly 400 kw. It is possible that the engine would run double that. If you had dynamos that would run 800 kw instead of 400, they would cost very nearly twice as much There is no overloading of the dynamo to anything like the extent there is of the engine. The excess power of the boiler has already been discounted in its installation. On the other hand, the battery, although guaranteed for 1600 amperes, is said to run 4800 for 15 or 20 minutes, if it has to, and Mr. Edgar said he would not hesitate a moment to put that on if necessary, and therefore the element of overloading in one, is about equal to what it is in the other.

Mr. J. B. Entz stated that he had recently spent a year in the factory of the Tudor Company, in Germany, and had occasion to know what their practice is in that country, and what their results have been. They have a great many large central stations, which have been installed from ten to six years. The opinions of all engineers with whom he spoke upon the subject were the same as those expressed by Mr. Edgar. He had met engineers from Siemens & Halske and the Allgemeine Electricitäts Gesellschaft, Schückert & Co., Oerlikon and other large companies, and whenever he started to criticise the battery in any way he was rebuked with the statement that it might be so in this country, but that the results were different there, and the results were very satisfactory. The company ships 60 tons of battery a day. In Hanover, where they have had an installation for six years, the efficiency was 83½ per cent. for the entire year's work, and the loss of energy but 5 per cent. of the total output. The company sells the batteries with the capacity specified for the different rates of discharge. The customer may discharge it one hour, two hours or ten hours as he pleases, and it does not affect the guarantee. The purchaser has the option of taking the battery without any payment for guarantee for two years. The company keeps it in perfect repair for that time. At the end of two years the purchaser can take a guarantee from the company of 4 per cent. a year for ten years, but very few of them care to do that. The actual expense of maintenance has been 2¼ per cent. to the company. In that time they made considerable money out of that 4 per cent guarantee.

Mr. J. R. Williams said the efficiency of the Boston battery, as Mr. Edgar stated, does not vary except within a very small fraction as the discharge rate increases; that is to say, a battery that would give a watt-efficiency discharge at a ten-hour rate of 80 to 85 per cent. would still give a watt-efficiency of 78 to 84 per cent. if discharged at a two-hour or a one-hour rate. The capacity would decrease as the discharge-rate increased. But if a certain capacity is taken out at a high-discharge rate, it would only require charging to the same extent as the amount of current that had been previously discharged.

The Geometrical Form of Transformer Plates.*

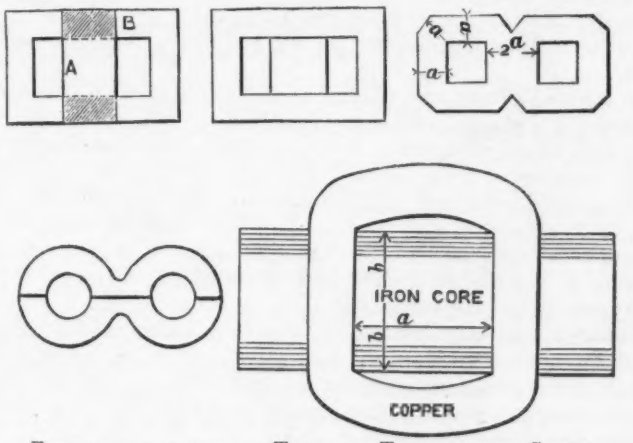
BY GEORGE ADAMS.

In designing transformers for high efficiency, it is necessary to reduce the volume of iron used in the core to as small dimensions as possible. In most cases, however, the dimensions of the core are fixed by certain conditions of output and first cost, and the chief considerations are then to dispose the iron in the core to the best advantage, so that every portion of the iron comprising the magnetic circuit shall form a path for the magnetic flux, and avoiding the use of redundant iron.

The form of plate shown in Fig. 1, in which the part *A* is stamped out of the plate *B* and placed crossways to form the transformer core, is faulty, inasmuch as it contains superfluous iron. Those portions of the plate *A* which overlap the plate *B*, as indicated by shade lines in Fig. 1, do not add anything to the effective area of the magnetic circuit, while they tend to increase the weight of the transformer, and consequently to augment the iron losses. The advantage claimed for this type of plate is that no metal is cut to waste, the whole being utilized to form the magnetic circuit, and the cost of manufacture is reduced accordingly.

As a set-off against this, we have to consider the fact that more iron must be employed than is actually required for the magnetic circuit; it is questionable, therefore, whether there is any real saving in first cost.

A better form of plate is shown in Fig. 2. In this case there is no overlapping of the plates; a transformer made up of this type of plate would consequently be more efficient than if made up of plates like Fig. 1.



FIGS. 1, 2, 3, 4 AND 5.—TYPES OF TRANSFORMER CORES.

A form of plate which would be still more effective is shown in Fig. 3. In this case the corners of the plate are cut away so that the distance (*a*) from the corner of the aperture is equal to the width (*aa*) of the sides of the frame.

These corners do not add anything to the effective cross-section of the magnetic circuit, while they tend to augment the iron losses. In order to obtain the shortest length of area of aperture for the coils, the aperture should be square—not oblong; the square is, by the nature of its geometrical form, the rectangular figure which encloses the maximum area for a given perimeter.

By an extension of the same reasoning, the plate shown in Fig. 4 would give still better results. In this case the transformer plate consists of two annular plates joined at their peripheries.

The plates might be divided along their horizontal centre line and afterward clamped together when the plates are assembled to form the complete transformer. This would be a good method of construction, as ready access to the coils could be obtained, should any repairs to the insulation be necessary.

There is no superfluous iron in this form of plate. The plates would be individually more costly than the plates shown in Figs. 1, 2 and 3, but it is probable that the total cost of the iron core would not be greater, for the diminished weight of iron required would

* From the London *Electrical Review*.

compensate in a great measure for the increased amount of metal cut to waste.

A comparison of the weights of the above forms of plate, allowing the same effective area of magnetic circuit in each case, is instructive.

Taking the area of Fig. 1 as unity, the relative areas of Figs. 2, 3 and 4 are as follows: Fig. 2 = .834, Fig. 3 = .792, Fig. 4 = .697. The weights of complete transformers having the same sectional area of core in each case, and taking w to be the weight of a complete transformer made up of plates like Fig. 1, would be:

Fig. 1 = w.
" 2 = .834 w.
" 3 = .792 w.
" 4 = .697 w.

The weight of iron in a 10-kw transformer, made up of plates as in Fig. 1, working at a flux of 3000 lines per square centimetre, or three kilogausses, was 592 pounds. The corresponding weights for the other three types, assuming the section of the core to be the same in each case, were:

	Weight of iron in pounds.	Iron loss in watts at 100 alternations.
Fig. 1.	592	236.8
Fig. 2.	493	197.2
Fig. 3.	470	188.0
Fig. 4.	414	165.6

The iron losses correspond to full load.

Comparing Figs. 1 and 4, it will be seen that a reduction in the iron losses of 30 per cent. may be effected by a judicious distribution of the iron in the transformer plates.

The copper losses would be the same in each case, and for a transforming ratio of $\frac{2000}{100}$ would amount to 119 watts.

The best form of section for the core of the complete transformer, when built up of plates, would be square, as in Fig. 5, since the square is the rectangular figure which contains the greatest area with a given perimeter. Under these conditions, the length of the copper circuits would be a minimum for a given area of iron enclosed by them.

In the case of small transformers, such as are used on distributive systems, it is of considerable importance to keep the length of the magnetic circuit as small as possible, because the magnetizing current increases directly as the length of the magnetic circuit; for this class of transformer it may, therefore, be advisable to make the length b somewhat greater than a, Fig. 5, thereby reducing the length of the magnetic circuit, although it involves a greater length of wire in the copper circuits, and consequently greater $C^2 R$ loss. The best relation between a and b can be found by trial.

In the case of large sub-station transformers, the no-load current need not be considered, as the transformer can be switched out of circuit by the attendant when not required. The core of such transformers may therefore be made square, provided the cooling surface is sufficiently large.

New Brown Three-Phase Generator.

Among recent polyphase power-installations in Switzerland is one at Schoenwald, which drives the machinery of several shoe factories, employing 4000 hands. The type of generator used is shown in the accompanying engraving, reproduced from London *Engineering*, and was designed by Brown, Boveri & Co., of Baden, Switzerland.

In order to save space and obviate loss by gearing, the alternator had to be mounted on a turbine shaft making only 30 revolutions per minute, thus involving a low periodicity; and in order to be available not only for power, but to a small extent also for lighting without transformers, it had to be designed for low voltage. The machine consists of a circular gun-metal frame carrying the stationary armature, and of an inside six-armed spider fly-wheel carrying the rotary magnetic field, the latter being 8.9 feet and the former 10.4 feet in diameter. The magnetic field is composed of 80 rectangular poles cast with the rim of the spider wheel. Forty of these pole-pieces are naked, while the 40 intermediate ones carry insulated wire coils wound on paper frames which fit the pole-pieces. To prevent the wire coils from moving or becoming loose, there is fitted and screwed to every adjoining naked pole-piece a rectangular brass-guard frame or shoe whose wings extend to the edges of the two adjoining pole-shoes, and press against the wire coils, thus holding them securely in position. The armature coil, clamped between the inner rings of the frame, consists of insulated laminæ of sheet-iron with a double row of circular equidistant holes near the periphery, into which are inserted insulated copper bars in two rows of 240 bars each.

The upper and lower ends of every pair of front and back bars are respectively soldered together, the back bar having its upper portion bent in one direction, while the front bar has its lower portion bent

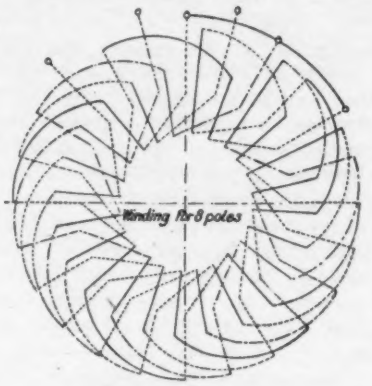
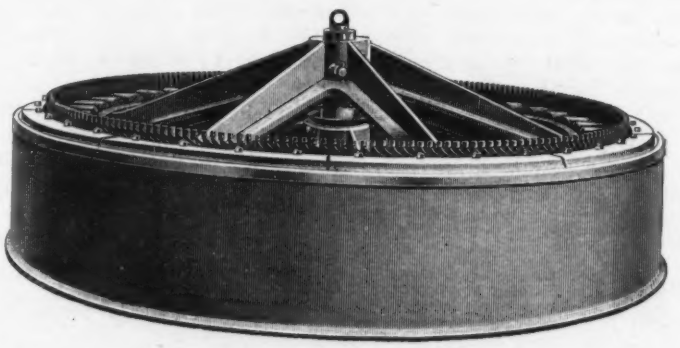
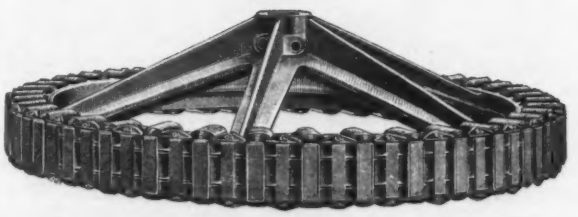


Diagram of Windings.

in the opposite direction. The arrangement thus constitutes a drum rather than a star winding, and is shown, for eight poles, in diagram. At 30 revolutions per minute, corresponding to $0.5 \times \frac{80}{2} = 20$ cycles per second, the output of the machine at 173 volts is 250 amperes multiplied by 1.73 for three-phase, or 74 kw or 100 hp.

The exciting current is derived from a 40-hp direct-current bipolar dynamo, which makes 670 revolutions and is driven by bevel gearing from the same turbine that drives the generating alternator. The excitation is 17 amperes at 200 volts, equal to





Armature and Field.

3.4 kilowatts, or 5 per cent. of the effective output of the alternator. The total weight of the machine is eight tons, equal to 121 kilogrammes or 266 lbs. per kilowatt of effective output. The loss due to armature reaction is 3.85 per cent., and the efficiency, including excitation and all frictional losses, is 90 per cent., under all conditions of working.

Suicidal Improvements.

In a recent discussion in England a speaker drew a sad picture of the downfall of electric refuse destructors due to their own prosperity. If they can supply electricity as cheaply as is claimed, the gas companies will be compelled to reduce the price of gas to such a low figure that householders would adopt gas fires and abandon the coal fires, and then there would be no cinders or ashes, and, therefore, no fuel for the refuse destructor.

Errors In Testing.

In a recently published book* on electrical measurements, Prof. Eric Gerard treats in a preliminary chapter, in a clear and simple manner, the subject of errors met in testing; these are enumerated as due to the method employed, the instruments used and to the observer himself, and are divided into two classes, called constant or systematic and fortuitous or variable errors.

The first class comprises the errors which affect the result in a definite sense always the same. They may be due to a false method, a defective apparatus or to a physical failing of the observer. The displacement of the zero of a galvanometer and the slowness of an observer in marking time are examples of systematic errors.

Such errors can only be corrected by varying the methods of observation, the instruments or the observers; the comparison of the several results with the mean result permits them to be estimated. The conditions of testing may often be modified in such a manner that a positive error becomes negative, this giving an exact mean. For example, the displacement of the zero of a galvanometer increases or decreases the reading made on the scale according as the current passes through it in one sense or the other.

Changes, such as are due to the influence of temperature on the length, or the electrical resistance of a body, the effect of changes in the earth's magnetic field on magnets, and to polarization of batteries, should be regarded as systematic errors that can be corrected when the magnitude and mode of action of the causes are known.

The second class of errors are characterized by the property of giving indifferently values greater or smaller than the true value. Thus, when an observer measures several times with a standard metre a length of several metres, he generally obtains different results, which may be either greater or less than the true value.

When all observations are made with the same care, the most probable value is furnished by the arithmetical mean. This mean value eliminates, as far as is possible, variable errors, but the result is still affected by constant errors, which, in the preceding example, may be due to a curvature of the standard metre, a defect in graduation, etc., and for which separate corrections should be applied.

It is important to insist on the necessity of observing the same care in all of the measurements entering into the mean. Beginners have a tendency to be guided by the first results obtained, and to reject any differing from these in order to obtain a table of concordant values. At other times, the observers have a preconceived idea of the result and eliminate observations differing from it. Even if he knew the value which he ought to obtain, the observer ought to act as if he were ignorant of it, and only throw out such results that differ from the mean through an evident fault. The last results should be noted with as much care as the first; they have even a higher value since, in the course of testing, the observer acquires skill.

It is well to become accustomed to estimate to the tenth of the last division of the scale used. Even if the cross-hairs or the reading index are rather coarse, it is better to write the fraction estimated in tenths than under the form ½ or ¼, if for no other reason than that the possible error is .5 or .25 of a division in the latter case. With the cross-hairs sufficiently fine, it is easy to estimate the tenth of a division, corresponding to .5 mm, in which case the maximum error is .05 of mm.

The mean of the results have the more chance to approach the true unknown result, as the values found differ less among themselves. A comparison in this respect is afforded by the *mean error*, defined by the mean of the differences between the mean result and single observations, algebraic signs being neglected. Thus, suppose that measures of lengths have given the following numbers:

Feet.	Differences.
167.95	+19
167.45	−31
167.60	−16
167.60	−16
167.87	+11
167.88	+12
168 00	+24
167.85	+ 9
167.82	+ 6
167.60	−16
Mean result.....167.76	Mean difference.. 16

The result is 167.76±0.16 feet, which should finally be corrected for constant errors. If the constant errors have varied during the observations, each partial result should be separately corrected before the calculation of the mean.

The number of observations to adopt depends upon the differences which exist between them; if the differences are small, it is evidently useless to multiply measurements. In every case the calculation of probabilities teaches that the confidence to be placed in a result increases, not as the number of observations, but as the square root of the number, which need rarely exceed 10.

The *relative mean error* is the ratio of the mean error to the result. In the preceding example, this error is $\frac{.16}{167.96}$, or about .001; that is to say, one part in a thousand. As will be seen, it is the relative mean error which serves as a basis of discussion in testing.

Probable errors follow a law discovered by Laplace, known as the law of "least squares," which permits their values to be calculated, the latter, however, remaining subject to unknown systematic errors. In electrotechnical measurements the latter are often larger than the former and difficult to eliminate. It is therefore rarely useful in such measurements to resort to the complicated calculations of the method of least squares. The mean error is sufficient to indicate the value of observations, and if the precision of measurements involves the determination of probable errors, resort may be had to special treatises on this complicated subject.

There is a class of errors, thus far unnoticed, due to blunders in observation or calculation, incorrect copies of results, etc. These errors are often evident on simple inspection of results, and can be avoided by the exercise of care and order.

When a result is obtained indirectly by means of experimental data, from the point of view of the discussion of the method and of more favorable conditions of testing, it is well to fix the influence of the mean errors committed in the various observations on the final result. When, for example, a current is measured by means of deviations of a galvanometer, it is useful to verify what importance an error in reading can have on the value of the current. It is, therefore, necessary to define at what point of the scale the influence of the error in reading is the least. It can be determined by experiment between what limits it is possible to vary the current without sensibly modifying the deviation of the galvanometer; but it requires long trials to determine at what portion of the scale the relative error due to defective sensibility in the instrument, is smallest; calculation, however, permits the direct solution of this problem.

It is not less important to eliminate the influence of partial errors in order to determine what observations should be made with the greatest care, and those in which the error is of little importance. By so doing the time disposable can be utilized in the best manner possible.

*Mesures Electriques. Lecons Professees a l'Institut Electrotechnique Montefiori annexe a l'Universite de Liege. 487 pages; 198 illustrations. Paris: Gauthier-Villars et Fils.

Engineering, Mathematics and Physics.

In a paper in the December number of the *Harvard Graduates' Magazine*, Prof. Ira N. Hollis says that an important consideration which enters into the framing of a course for engineering is the treatment of mathematics and physics. Engineering, in the abstract, is a branch of both sciences; but the principal question that meets one in carrying out any problem in construction is the economic question. One of the main elements of success is a thorough knowledge of materials and their combinations into the most economical forms. The formulæ to be applied in determining the strength of modern structures and machines may be worked out by the mathematician, but there is always a factor or coefficient determined by experience. This experience must begin in the schools, in order that men may appreciate as early as possible the value of gaining knowledge after graduation in such a form that it can be used. The great danger to the engineer, therefore, in the exclusive study of mathematics, lies in the tendency to work out everything from the ideal standpoint, and to neglect the more important practical coefficient.

The same may be said of physics. The study of physical science is of the greatest value, yet there is constant temptation to follow methods too refined for the workshop. The occupation of the physicist is mainly with extremely accurate methods of studying the laws of nature, while that of the engineer lies with very fair approximation to the results worked out in the laboratory. For this reason the engineering student is often the terror of the physicist. Usually he has little time to spend over small experiments. Occasionally our schools develop a man whose talent and capacity for work will enable him to study and to retain the higher branches of mathematics and physics, and at the same time to grasp their practical application to the need of modern life.

A Critic Criticised.

To the Editor of The Electrical World:

Sir: I have been reading a very excellent work on the "Intellectual Rise in Electricity," by Park Benjamin, who gives quite an extended account of the work done by Peter Peregrinus, who was born about the year 1266. On page 174 of this book, reference is made to an alleged error in a statement of Peregrinus, in which preconceived theory is supposed to have led him astray. I quote from the book as follows.

"It has already been stated that in giving names to the poles of the magnet, Peregrinus calls that pole 'north,' which points to the north when the needle is supported so as to be freely moved. He says, 'You will infer what part of the iron is attracted to each part of the heavens from knowing that the part of the iron which has touched the southern part of the magnet is turned to the northern part of the sky. The contrary will happen with respect to that end of the iron which has touched the north part of the stone; namely, it will direct itself toward the south.' It is difficult to see how he could have made this error in the face of his experiments; for, as a matter of course, the end of the needle which touched the south part of the lodestone must have acquired north polarity, and, therefore, have pointed to the south, which is exactly the reverse of what he states."

Now, bearing in mind that the north pole of the magnet, as Peregrinus defines it, is that pole which points to the north when the needle is freely suspended, it seems to me that Peregrinus was correct in his statement, and that his 19th century critic has fallen into the error of mixing up the more modern naming of the poles with the naming which Peregrinus clearly defines; in other words, I think that the magnets when charged in the manner described by Peregrinus would act exactly as he states, and that that part of the iron which touches the southern part of the magnet, which would be a north pole, would point "to the northern part of the sky," and that that part of the iron which "touches the northern part of the stone" would become a south pole and "will direct itself toward the south."

Albany, N. Y. James F. McElroy.

The Electrical World Index.

To the Editor of The Electrical World:

Sir: While in Chicago last Fall I called on your Western manager, and in my conversation with him I told him how valuable I found The Electrical World, but added that one feature would greatly enhance its value, viz., a well-arranged index to the back numbers, additions to which could be made in the form of yearly supplements. I explained to him the very great need of such an index to all engaged in electrical pursuits, and especially to teachers and students and others doing original research. In conclusion I said that while it would not pretend to be a complete index to electrical periodical literature, yet the back numbers of The Electrical World alone contained a great mine of valuable data and information, which would cover a large part of just that electrical literature most needed for easy reference. Moreover, I believe it to be true, that no American journal to-day, all things considered, is better able to grapple with such a difficult problem and carry it through with the success it deserves, than is the enterprising and progressive Electrical World. I sincerely hope you will try it and earn the gratitude of your many readers and admirers.

If such a plan meets your approval, may I be so bold as to offer one suggestion? It is to have the references composing the index printed on *one side only* of the paper, in order to make it possible to cut off the separate references for pasting on to cards of a card catalogue. In common with many others, I find that the card index method is the simplest and most practical way of preserving engineering data, especially when used in connection with a full decimal system. I find that the system of Dewey is wofully incomplete on electricity. It is a pity that some of our leading electrical engineers and teachers cannot coöperate in preparing an authoritative decimal classification on electrical subjects; in fact just as authorities in other lines prepared the matter for the large Dewey Index now on the market. William Esty.

University of Illinois, Urbana, Ill.

[A General Index of The Electrical World from Jan. 6, 1883, has been in the hands of the printer for some time, and will be published early in the Spring. As the sheets are bound from time to time to meet demands, the indexes of volumes up to date will be included; the latter will also be printed in pamphlet form, so that purchasers of the General Index may thus, at intervals, have these bound uniformly with the General Index.—Ed.]

Theories of Magnetism.

To the Editor of The Electrical World:

Sir: In The Electrical World of Dec. 7 I observe a short paragraph in which the following definition of magnetism is given: "Magnetism is the connecting link between mind and matter, or rather the medium by and through which the Divine energy is imparted to all matter, and the primary exhibition of this energy is an exercise of God's will. The Deity is the omnipotent magnet. Electricity is condensed magnetism, and electricity, light, heat, gravity, sound, capillary attraction, repulsion, attraction, disruption, and explosion are modifications of magnetism, and are influenced by it."

It is gratifying to see the many earnest endeavors to solve the so-called mysteries of magnetism and electricity, which to me have long since ceased to be mysteries, but only wonders of nature. This may appear arrogant; if so, I sincerely ask pardon of all who think so, especially when such gentlemen as Prof. Silvanus P. Thompson, for whose writings I have the greatest respect, say that "the relations between magnetism and electricity are a mystery yet to be solved."

The statement that "electricity is condensed magnetism," is nearer to the philosophy of Swedenborg than anything I have as yet met with; according to which philosophy the *corpuscles surrounding each particle of ether*, and forming its envelope, are condensed magnetism, and that *motion* of the ether is the cause of electrical phenomena, which are its *effects*, and that disruption of these ethereal corpuscles causes them to unite with iron effluvia (when present) constituting magnetism; and further, that electricity, magnetism, light and heat are modifications of one common force.

St. Louis, Mo. Henry Greenway.

In a clipping accompanying the foregoing letter, giving a report of a lecture, the views of Mr. Greenway on electricity and magnetism are set forth more in detail, and from it we extract the following paragraphs:

"Prof. Greenway represented the earth as a huge ball, wound round with strings of beads in a spiral manner, so that if they were ducts anything passing through them would pass from north to south. Each of these beads, he said, represented one of these masses of active spirals. Each spiral was whirling, and thus they were whirling each other. The spiral, he said, resembled two spiral bed springs with their small ends put together, and this electrical or magnetic current passes down about the earth in the direction represented by these strings of beads, enters again at the South Pole, passes up through the earth, overflows again at the North Pole, and then again down over the earth. It is a perpetual motion spiral, and like the pictures shown at stereopticon exhibitions of a wheel, which seems to roll continuously out from its centre.

"Two currents of electricity, Prof. Greenway showed, had comparatively no effect, one or the other. But the minute a piece ofiron, causing a magnetic force, was introduced into one of the coils, the effect was very apparent in the repulsion. This, he said, showed the presence of iron effluvia, which forms the active centres necessary to make up a magic sphere. Referring to the manner in which a current of electricity is commonly supposed to travel, no one heretofore, he said, had clearly explained the philosophy; surely it did not travel from one place to the other, as it would occupy time. He then explained that current of electricity was composed of millions of these gyrating spirals, interlocked and interwoven, and if one of them is turned, the whole string of whirls around the conductor is set in motion instantaneously. This explains that instantaneous transmission, in reality, is not transmission, but simply a disturbance of various particles in a long chain of closely woven globules."

The journal from which the above is extracted announces that Prof. Greenway proposes putting his discoveries into practice and will shortly place a new electric motor before the scientific world.

A Sanguine Prophet.

Referring to the recent trial of the Lamb system of electrical towage on the Erie Canal, an electrical writer in a popular engineering magazine says he believes that "the equipment of the whole Erie Canal will swiftly follow, section by section." The same writer quotes, without comment, the statement that, through the production of calcium carbide, "the whole business of gas making is to be revolutionized." And yet some people wonder where the general public gets its misinformation on electrical subjects.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

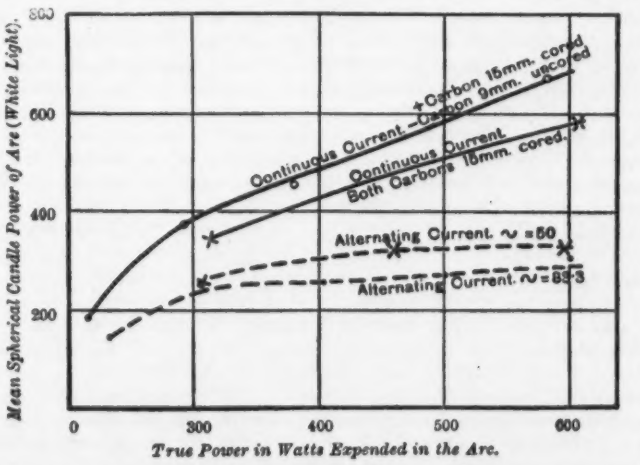
Speed-Voltage Curves. GRIFFITHS. Lond. *Elec.*, Dec. 30.—He discusses analytically and graphically the curves showing the relation between speed and voltage which are of direct importance when the prime mover is uncontrollable or subject to great fluctuations as for train lighting or in connection with windmills ; he also discusses the subject of the critical speed.

Some Characteristic Properties of Synchronous Motors. KOLBEN. *Elek. Zeit.*, Dec. 19.—He refers to the well-known V-curve of Mordey, and give it for a 15-hp, three-phase synchronous motor for various loads, and in another figure the corresponding consumption in watts; (this V-curve gives the variation of the armature current, with the excitation, the speed of course remaining constant;) from these curves he shows that the minimum armature current corresponds to a nearly constant excitation current, for a constant primary voltage and for all loads, even an overload, and therefore a regulation of the exciting current, even with greatly varying loads, is not necessary; furthermore that even with great variations in the excitation at all loads, the efficiency is not altered, remaining nearly constant; this is a property only of a good synchronous motor, that is, one with small self-induction, and which would as a generator have a very small drop in voltage between no load and full load; with a motor having a strong armature reaction the consumption of power increases very greatly with an increase of the armature current; to show this he gives the curves of the consumption of power for a good and a poor motor and for an alternator on short circuit ; the good short circuit curve shows chiefly hysteresis loss besides the negligible copper loss, while the bad one shows chiefly Foucault current losses ; the former has the shape of the well-known hysteresis curve, while the latter that of the quadratic Foucault current curve which increases rapidly with slight increase in the excitation. The V-curve at no load for the synchronous motor, like the short-circuiting characteristic, enables one to judge of the good properties of the machine ; the steeper the two sides of the curve, the better the machine for a synchronous motor, that is, the less liable it is to get out of step, and the better the generator for inductive loads, particularly in reference to loss of voltage ; it is only motors with good V-curves that can be used, as suggested by Swinburne, to advantage as generators for generating the no-load current, or used as phase regulators, that is, as over-excited synchronous motors running without a load to generate the wattless current. A very characteristic factor in synchronous motors is the current in the armature when short-circuited, with variable excitation ; the greater the magnetic dispersion, the smaller the current for the same excitation; a motor capable of being overloaded has in general a weak armature field and therefore a short circuit characteristic showing rapidly increasing currents beginning even at small excitation; an example is given; he deduces the approximate rule of thumb that a motor may be said to be good, if with a short-circuited armature the current for full load is generated for an excitation which on open circuit would generate about one third of the normal voltage; with the aid of these short-circuit curves the loss of voltage of the machine, when used as a generator for inductive loads, can readily be determined. The form of the E. M. F. curve is not an unimportant matter in connection with synchronous motors; if the generator and motor are of similar design, then the shape of the curves will in general agree with each other, and the minimum current for the most favorable excitation, that is at the point of the V-curve, will for all loads approximately correspond with the watt-current; if the motor and generator are constructed differently and if, say the generator, gives a sine curve and the other a jagged curve, then the point of the V-curve at no load and for all other, loads will rise and the power factor will be reduced on account of the wattless component of the current, which will circulate to equalize the voltages; he shows how this may be determined, and gives illustrations. The operation of synchronous motors with the above-mentioned good qualities is very simple and reliable if the motors are constructed in accordance with the modern type of alternators without any moving wire; he gives illustrations of several sizes of synchronous three-phase motors made by the Oerlikon Company; on account of the favorable magnetic disposition these motors can hardly be made to fall out of step, and they run with a very good efficiency, as the exciting energy and the loss in the iron are very small.

Loss of Revenue Due to Cheap Transformers. ARMSTRONG. *Elec. Eng.*, Dec. 25.—He calls attention to the large amount of current taken by small, cheap transformers, on open circuit or at small loads, which he terms "leakage" current, and urges the replacing of these cheap, inefficient transformers by those having less leakage current; he also urges the substitution of a few large transformers for the large number of small ones, stating that the largest possible transformers should be used. He calculated the loss of revenue for a 20-light "cheap" transformer, that is, the money value of the leakage current, and finds it to be $27.38 per year or about 10 per cent. more than the first cost of the best of the high-grade transformers; five or six dollars a year are required to pay the difference in leakage alone between a good and a cheap transformer; he takes the case of an $18 and a $25 transformer for 1000 watts, the former having a leakage of 100 watts and the latter of 25, and finds that the cost of the lost energy for a year added to that of the transformer is $55 for the former and $34 for the latter, showing that the latter is the cheaper of the two in the end; he claims that first cost is a minor part in selecting a transformer and that the economy is much more important; he believes that if managers will discard all their cheap transformers and use only a high-grade article, there will be a saving in the first year; some estimates are given.

LIGHTS AND LIGHTING.

The Alternating-Current Arc. FLEMING and PETAVEL. Lond. *Elec.*, Dec. 20.—An illustrated article giving the preliminary results of some interesting experiments, forming part of an analytical study of the alternating-current arc ; a complete publication of the details is to be given later. A short article by Fleming was abstracted in the *Digest*, Nov. 17 ; Dec. 8, 22, 1894 ; Jan. 4, 1895 ; the present is the result of similar experiments repeated with greater care. Two lamps were selected, one being for continuous currents and the other for alternating currents, they being chosen with a view to good regulation and steady working over wide limits of power comsumption ; for measuring and regulating with great accuracy the power taken by the arc itself and not including that in the mechanism, a reflecting wattmeter was constructed, a brief description of which is given ; the fine wire movable coil has a bi-filar suspension of exceedingly fine silver wires; besides this the current through the arc and the voltage between the carbons was taken by properly corrected instruments; the length of the arc was also measured; the photometric measurements were made with a Sugg's star disc photometer, using as a standard a somewhat forced incandescent lamp; "it was found that by focusing the eye for a point rather nearer to the eye than the images of the photometric disc, the color difference between the two images became less distracting"; the measurements were made in terms of a white light standard only; the power supplied to the arc was kept perfectly constant, which could readily be done by means of the reflecting wattmeter; observations were taken with expenditures of power varying from 200 to 600 watts, and for the alternating current they were repeated for two frequencies, 50 and 83.3, the photometric curve being measured in each case, and the mean spherical candle-power calculated in the usual way by means of Rousseau's diagram; for the alternating current both carbons were 15 mm in diameter and were cored: the results are given in the accompanying curves, which explain themselves; the general results confirm the conclusions reached a year ago in the article above cited, and show that for a given amount of power, under the conditions of these experiments, the mean spherical candle-power for continuous currents is nearly double that for



alternating currents. For the alternating current arc the spherical candle-power, for a given amount of power, depends on "the form of the carbon potential difference curve," that is, on the wave form; a set of these curves is given. These experiments do not exhaust the subject and the question whether continuous-current arcs are more efficient than alternating cannot be answered in a general sense, but must be settled for any particular instance; whether any particular form of alternating-current arc can be produced which has the same efficiency, they believe, has too purely an academic interest to make it worth while to spend time on it; but the present experiments amply justify generally the opinion which has been held as to relative inefficiency of the alternating-current arcs apart from the question of distribution, "and shows the correctness of the opinion which dictates the employment of continuous current or rectified alternating current for public arc-lighting purposes." The second part of the investigation was concerned with an analytical examination of the periodic variation of the light coming from various parts of an alternating-current arc; in this a disc of aluminum with slots in it was rotated by means of a synchronous motor run with the same current which operated the lamp; this enabled the light from any particular part of the arc of the carbons to be measured for any particular point on the current curve; owing to the slow variation in the total illumination of the arc, it was impossible to measure these instantaneous values against any fixed standard, with any chance of obtaining accurate results, but the difficulty was overcome by using the arc itself as a standard, balancing the light obtained through the slots with that of the arc itself, the latter being reflected by means of mirrors onto the opposite side of the screen, the mirrors being moved to bring about a balance; by means of lenses the light obtained from different parts could be measured, the instantaneous value being balanced against the mean value from the same part of the arc or carbons; the motor at the same time made the intermittent contact by means of which the current and E. M. F. curves of the arc were measured; diagrams of the results are given; it was found among other things that the blue or purple light forming the true arc undergoes a periodic variation, the intensity completely vanishing at a certain instant, but there is outside of this true arc a halo of golden light which is persistent and therefore the light from the true arc never becomes zero; a diagram is given for the light from the centre of the crater; when the lower carbon is negative the maximum light emitted from the centre of the crater on the lower carbon does not reach such a maximum value as it does when the same carbon is positive; for a frequency of 83 it is not much more than one half as great; the lower the frequency the greater this difference; whether that carbon is positive or negative can be found by holding a magnet at the back of the arc and noting the direction of deflection of the image. From the curves it is shown that there is a certain lag in the one representing the variation of light from the carbons, behind the curve representing the power, showing that the light lingers after the power has fallen to zero; there is also a very slight difference of phase between the current and the E. M. F.

True Resistance and Back E. M. F. of the Arc. Ayrton. Lond. *Elec. Rev.*, Dec. 20.—He points out some errors made by Prof. Thompson in his Cantor lectures (*Digest*, Dec. 7 to 28). In the original paper of Ayrton, which Thompson quoted, it was not stated that the back E. M. F. was negative, but that if an arc really possesses a back E. M. F., and a true resistance, then, in spite of the experiments of others, this true resistance must be a negative quantity for solid carbons. He states that Mr. Frith is making experiments to measure the true resistance of the arc, an account of which will soon be published. The results obtained have all corroborated the conclusions of Ayrton's paper at Ipswich, namely; that when a system of testing, such as would give the true resistance of an arc possessing a back E. M. F. and a resistance, is applied with all necessary precautions, and an arc formed between solid carbons, a negative value for the resistance is obtained. He states that the small correcting term in his formula, which Thompson omits, completely alters the character of the formula for short arcs when omitted. He gives the original formula, and discusses it at some length. In his original paper he gives an illustration showing that the true formula expressing the voltage required to send a current through a copper wire, if written in a particular form, would convey the impression that in every copper wire there is a back E. M. F., if we knew as little about the resistance of a copper wire as we know about the true resistance of the arc. As an illustration of the results of exterpolating he gives some figures regarding a Gramme dynamo, in which exterpolating would lead to the wholly wrong conclusion that if a series-dynamo be running at a fixed speed, and be sending a current through an external circuit containing no E. M. F., the mere gradual increase of the resistance of this external circuit will cause the dynamo to reverse; this is given as an analogy to show that an equation obtained from experiments on arcs of finite length, should not be used, by exterpolating, to give information about infinitely short arcs, especially when an attempt to obtain the minimum value of the voltage by bringing the carbons nearly together, at once starts hissing and alters the entire conditions of the experiment.

The Arc Light. Thompson. Lond. *Elec. Rev.*, Dec. 20; conclusion of his third lecture.—He describes the mechanism of a number of arc lamps, among them several for lanterns.

The Mistaken Idea of Artificial Light Improvers. Birchmore. *Elec. Eng.*, Jan. 1.—He cites an article by Meyer in which an attempt was made to compare different lights according to the nature of the light which they emit, and claims that the argument is not a good one, giving his reason for believing so; he endeavors to show that it is a purely physiological factor which is at the bottom of the present difficulty with our lamps, and that it is not the light as measured by a photometer that is important, but the brightness of certain colors; he has developed a simple method of tinting glass, by which he claims that the color of the light from incandescent lamps can be made the same as daylight, every color having nearly or quite its true value. "Even Palaz, who of all men ought to know better, sets up the light of the glow worm as the ideal"; he believes that even if such a light of any desired intensity could be made, the human eyes would "declare that after all it was only a makeshift for the sunshine and a poor makeshift at that"; he considers the true ideal to be the sunshine, and believes that it is doubtful whether it would be a good thing if artificial light, like sunlight, could be produced without heat. "Just as long as 75 per cent. of the reflected visual intensity of the sunlight is longer in its waves than D, and it will be so probably for some time yet, it would be better policy on the part of those interested in improving lamps to adopt it as their ideal, rather than try to attain one to which they must educate the light sense of mankind; a task from which the most enthusiastic of the believers in the public school system would shrink, if he were able to understand the meaning of his ambition."

POWER AND HEAT.

Dust Destructors. Manville. Lond. *Elec.*, Dec. 20.—An abstract of a paper on "The Use of Dust Destructors as Steam Producers for Electricity Supply-Stations"; the paper was referred to in an abstract in the *Digest*, Jan. 4; it is based on experience in connection with the Shoreditch and the Swansea schemes; the paper is editorially discussed in the same journal; in the discussion it is thought that the weak point in thermal storage was the increased prime cost as compared with the storage-battery. The Lond. *Elec. Rev.* contains a communication from Mr. Manville; both journals give an abstract of the discussion of the paper.

Electricity in Oil Engines. Lond. *Elec.*, Dec. 20.—In a detailed reference to the Kane & Pennington motor (American) it is stated that a surprising feature is the apparent action of what has been termed an electric "mixing" spark; it works on the ordinary Otto cycle and toward the end of the compression stroke and electric non-ignition spark is passed through the charge, the effect of which is said to be to completely vaporize the oil and thoroughly mix it with the air; a second spark at the commencement of the working stroke ignites the explosive mixture; in the absence of further explanation as to this mixing spark, judgment as to its probable efficiency is reserved.

Cranes. Richards. *L'Eclairage Elec.*, Dec. 14.—In his long serial on mechanical applications he gives some good, illustrated descriptions of a number of different systems of overhead traveling cranes, as also some on surface tracks.

Utilization of the Tide. Elek. Zeit., Dec. 19.—An abstract from a daily paper stating that a proposition is under consideration to utilize the tides at the City of Papenburg, on the River Ems, for generating electricity for power and light.

The Electric Furnace in Chemistry. Moissan. *Pop. Sc. Mo.*, January; translated from *La Nature.*—A short summary of some of the most important results obtained by him in his very extended researches, more especially with the reverberatory electric furnace, which he devised in 1892, and in which he has made many improvements; most of the results have already been described in these columns during the past three years; the present article refers more particularly to the rare metals. The electric furnace enables one to deal with problems which were heretofore considered impossible; it has enabled him to produce the diamond, to crystallize metallic oxides, to reduce those which were heretofore considered refractory, to distill lime, silica, zirconia and carbon and to volatalize the rarer metals, as also those that cannot be fused; it enables one to study a whole series of small bodies which have heretofore been mere laboratory curiosities; he believes that our industries are about to undergo important modifications.

Slavianoff Casting System. Lohmann. *Elec. Eng.* Jan. 1. A reprint, with the illustrations, of part of the article abstracted in the *Digest*, June 22.

Traveling Crane. Elec. Rev., Jan. 1. A well-illustrated description of a traveling crane or hoist running on a suspended track through a carbon manufacturing plant, to lift the covers from the furnaces; the load is from three to four tons, the motor can develop 10 hp at 220 volts; a load can be carried at about 200 feet per minute; there are two trolley wires, one on each side of the channel iron.

Dust-Destructor. Manville. *El'ty*, Jan. 1.—A reprint of the abstract mentioned above. The editorial from the Lond. *Elec. Rev.*, mentioned above, is reprinted in the *Elec. Rev.*, Jan. 1.

TRACTION.

Gas Motor and Electric Traction. Elek. Zeit., Dec. 19; Editorial.—Reference is made to the gas-motor system which has been in use in

Dessau for over a year, and concerning which Mr. Schottler made a comparison of the cost of operation; he concluded that gas-motor traction is not only technically and commercially possible, but at least as cheap as the electric system; he estimates a cost of 4 cents per car km for gas and 5 for electricity, but this is not based on actual results. The editorial states that experience with the gas motors has shown that the above figure is too favorable, and that amortization, repairs and wages have been estimated too low; it is therefore probable that the above figure would in reality be considerably higher. It then gives in some detail the cost of operating electric railways as based on figures from the plant in the City of Halle, and obtains about 4.63 cents for an old and 3.71 for a new electric road, the grade on which was even greater than on the Dessau line; the operating cost of electric lines is therefore without doubt, less than that for gas-motor lines; attention is called to the large number of parts of the complicated machinery for the gas cars as compared with the two simple motors and gearing for the electric car; mention is also made of the noise, the unpleasant odor and the jerky motion. From actual observations on the gas-motor line it was found that the mean speed was 10 km per hour, although 15 was reached on it; the gas consumption is 400 to 500 liters per car km, to which must be added 15 per cent. for the work in compressing the gas; for a mean speed of 12 km therefore, 550 l of gas are required; an electric car for this speed takes an average of 450 watt-hours; if a gas engine were used to drive the dynamo, 400 l of gas would be required; the proportion of 400 to 550 therefore gives some idea of the relative efficiencies. It concludes that on lines on which there is a dense traffic, the gas-motor cars cannot compete with the electric; on the other hand, on long lines with little traffic on which electric traction would hardly be profitable, the gas car might compete with the horse car.

Controllers. *L'Eclairage Elec.*, Dec. 14.—An illustrated description of the Siemens & Halske system, adapted for operating the motors on each of a train of cars, by means of one controller on one car; the controller lever operates a shaft running the whole length of the car and mechanically connected by a flexible coupling to that on each of the other cars. It seems that there is only one motor on each car, and the starting must therefore be done by means of resistances which are switched in and out by turning these shafts; it is stated that only one starting resistance is necessary, although it appears that each car has its own trolley pole. The description also includes an electric brake operated by means of a special motor under each car, all of which are controlled from one end of the train. The brakes are automatic, and are put into operation by a rupture of the coupling between the cars; they may also be applied gradually.

Storage-Battery Traction Plant in Rome. *L'Elettricista*, December.—The street-railway plant in Rome, which was started in September, derives its power from the Tivoli-Rome alternating transmission plant, the current being transformed by a series of rotary converters; to avoid interferences with the lighting currents during the evening, a battery of 300 Tudor cells of 720 kw-hour capacity are being installed; the E. M. F. of a battery is kept constant by means of an automatic switching-in apparatus.

Railway in Kyoto. *Elec. Friend* (Japan), October.—The construction was started Feb. 1, 1894; it is a single-trolley system and a single-track road nine miles long; traffic began in September, 1895; there are 20 motor-cars running, requiring 200 hp; the power is generated by water; the total cost, everything included, was nearly $60,000.

Canadian Electric Railway. *West. Elec.*, Jan. 4.—An application is to be made at the next session of Parliament to incorporate a company to construct and operate an electric railway from Montreal to Windsor *via* Toronto and extending to Niagara Falls; also to have power to build branch lines to a distance of 25 miles from any points on the line; to supply heat, light and power and run street railways; editorially it is thought that the plan can hardly be taken seriously.

Nassau Railway. *Elec. Ry. Gaz.*, Dec. 28.—An illustrated description of the power plant.

Accumulator-Traction. SARCIA. *Elec. Ry. Gaz.*, Dec. 28.—The first part of a translation in full of the article abstracted in the *Digest* last week.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Fires and Electric Lighting. FLOOD-PAGE. Lond. *Elec.*, *Elec. Eng.*, Dec. 20; extracted from a daily paper.—He deduces from the reports for the years 1892, 1893 and 1894 the following figures for fires in London caused by different sources of light. The figures for these three years, respectively, are as follows: Candles 175, 235 and 157; gas, 265, 284 and 284; lamps, 373, 456 and 476; electricity, 1, 5 and 3. He adds that these facts will surely allay any feeling of uneasiness in the minds of users of the electric light as to there being any practical danger from electric light properly installed in their houses.

220-Volt Question. FLOOD-PAGE. Lond. *Elec.*, and *Elec. Eng.*, Dec. 20; extracted from a daily paper.—He views with some alarm the efforts of some electrical engineers who are advocating an increase of pressure to 220 volts; he considers that the lamp presents the smallest difficulty in connection with the matter, a far more serious question being whether houses wired with fittings and switches made for 100 volts can safely carry 220; before the change can be made every house must be carefully inspected; in his opinion it would be far better to be content with the usual safe pressure with which satisfactory results regarding fires have been obtained.

Walsall. Lond. *Elec. Eng.*, Dec. 20.—A long, well-illustrated description of this station. A high-tension direct current is used, as the lights are supplied over a widely scattered district; 2000 volts are used, and accumulators are installed in a certain number of sub-stations to supply the current for the lightly loaded hours of the day. At all times except at maximum load the generating station charges the accumulators and supplies current for the lamps at the same time; the station can therefore be worked at a fairly constant load; the greatest advantage of this system over the alternating is that the generator stations need not be worked more than eight hours a day, except, perhaps, in the middle of Winter; the generators give 40 amperes at 2000 volts and are separately excited; there is also a battery of accumulators at the station for lighting it and for supplying the exciting current; it appears that the current is transformed at the sub-stations, one of which contains a battery; there is also a booster having an output of 300 amperes at 35 volts for charging the accumulators, when placed in series with the low-tension current; the prospects of the station are said to be very good.

Tokyo Electric Lighting Station. *Elec. Friend* (Japan), October.—Four new alternators of 90 amperes, 2000 volts, and 72 field magnets have recently been added; the diameter of the field is about 12 feet, and the speed is 165 revolutions; they are direct-connected with a triple expansion condensing engine; the dynamo was designed by Prof. Mikano, of the Imperial Engineering College. The same issue states that a 300-light plant, driven by water-power, was recently started at Atami, a famous hot spring Winter resort.

St. Pancras. Lond. *Elec. Rev.*, Dec. 20.—A well-illustrated description of the new plant in which refuse destructors and a five-wire distributing system are used, together with balancing transformers; it appears that the gases from the destructors do little more than keep steam in stand-by boilers, and provide heat for the economizers.

Lucerne. PRELLER. Lond. *Engineering*, Dec. 20.—A well-illustrated description of the single-phase water-power installations.

Chicago Edison Company. *West. Elec.*, Jan. 4.—A long, illustrated description of the plant.

WIRES, WIRING AND CONDUITS.

Rules and Regulations. *Elec. Friend* (Japan), November.—The Japanese Electrical Association at its eighth meeting at Kobe in October, decided to ask the Government to issue regulations regarding electric light and power, and offered its services in preparing such a set of rules.

ELECTRO-PHYSICS AND MAGNETISM.

Influences of Vibration on the Resistance of Wires. MURANI. *L'Elettricista*, December.—A series of carefully made experiments with a view to settling this much debated question; to avoid the influences of heating due to friction, the vibrations in a series of metallic wires were induced by an electromagnetic tuning fork; wires of hardened iron, platinum, hard steel, hard copper, German silver and manganine were tested and in no case was any variation in the electric resistance detected by the most delicate methods. He concludes that the resistance of metallic wires is not altered by vibrations; all results to the contrary obtained by other observers are said to be due to frictional heat.

Cathode Rays. POINCARE. *L'Eclairage Elec.*, Dec. 14.—Jaumann recently attributed cathode rays to longitudinal vibrations of the ether; the present writer shows by means of calculations that this cannot be the case, and that these rays are not propagated in straight lines, but follow the lines of force, and he concludes that the hypothesis must therefore be modified, in order to accord with the facts.

Influence of Carbon on Iron. ARNOLD. *Proc. Inst. Civ. Eng.*—After describing a number of mechanical qualities of iron containing carbon in different proportions, he states that the magnetic observations on hardened steels have led him to the conclusions that the magnetic permeability varied inversely as the carbon present; the permanent magnetism was directly proportional to the carbides of iron present; and in iron containing between 0.1 and 0.9 per cent. of carbon the permanent magnetism was directly proportional to the special carbide of iron present.

Atmospherical Electricity. DARY. *L'Elec.*, Dec. 14.—A brief summary of the various theories which have been suggested.

Magnetization of Iron. ZICKLER. *Elek. Zeit.*, Dec. 19.—A reprint in abstract, containing the diagram and table, of the article abstracted in the *Digest*, Nov. 2.

ELECTRO-CHEMISTRY AND BATTERIES.

The Presence of Sodium in Electrolytic Aluminum. MOISSAN. *L'Eclairage Elec.*, Dec. 14.—A reprint of an Academy paper in which he shows that the contradictory results regarding the properties of aluminum are due chiefly to the difference in its composition; he has already shown that the metal can alloy with nitrogen and carbon, which modify its properties very greatly; he recently analyzed samples from the three largest companies, including the one at Pittsburg, and found a new impurity in the form of sodium, which he says has a very great importance in the durability of the metal. He describes how its presence may be detected;

from analysis he finds that aluminum contains 0.1 to 0.3 per cent. of sodium; when aluminum contains a small quantity of sodium it is attacked by cold water slowly at first, then with increasing intensity. The alloys of aluminum have entirely different properties according to the quantity of sodium contained as an impurity; he also discusses the effects of tin, showing the importance of using no solder containing this metal. Aluminum has a great tendency to form electric couples with all other metals, and it should therefore only be used by itself, and not in contact with such metals.

Electroplating Industry in the United States. Brunor. *Elec. Eng.*, Jan. 1.—A table showing the extent of the electroplating industry in the United States not including the electrotyping, etching and jewelry trades; there are 392 establishments of an aggregate capital of a little over $38,000,000; the value of the products is about $3,500,000.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Frequency. Wulf. *Zeit. f. Elek.*, Dec. 15.—A Mariotte bottle filled with water is placed on an iron support about one metre high, the lower horizontal opening in the bottle has a diameter of 2 mm; a horseshoe electromagnet, through which the alternating current is passed, is placed near to this iron support, which forms its armature and is therefore set into vibration; for each oscillation a drop of water from the bottle is thrown off, and the stream of water will therefore be separated into a regular series of drops, the number of which per second is equal to double the frequency; if this stream is examined through a stroboscopic disc, it is easy to adjust its speed so that the drops appear to remain stationary; the speed is then measured with a speed counter or by means of a chronographic arrangement. The results of some observations are given, and they are said to be correct within 1/6 of a per cent.; he considers it of great importance to be able to measure the frequency, and gives the results of some measurements made with central-station currents.

Relations Between the Electrostatic and the Electrodynamic Units. Hurmuzescu. *L'Eclairage Elec.*, Dec. 14.—A reprint of an Academy paper, in which he describes some recent carefully made experiments to redetermine this ratio; he finds that the value lies between 3.0005×10^{10} and 3.0020×10^{10}.

Absolute Dimensions. Raverot. *L'Eclairage Elec.*, Dec. 14.—He discusses the hypotheses of the absolute systems of dimensions of physical quantities; each system involves a hypothesis, which he discusses for the different systems.

Wheatstone-Kirchhoff Bridge. Kohlrausch. *Elek. Zeit.*, Dec. 19; abstracted from *Wied. Ann.*, Vol. 56, page 177.—He refers to some improvements in the form of a bridge in which the slide wire is carried on the surface of a cylinder. The accuracy is increased if two resistances are added, each 4.5 times that of the bridge wire, and so arranged that they may be inserted, either one or both, at either end of the bridge wire. By giving them this value it enables one to use the convenient Obach reduction tables. These resistances should be made of the same material as that of which the bridge wire is made; to enable them to be inserted conveniently, a plug commutator with six blocks may be used, or, better still, a large commutator of eight blocks. Another convenient addition to the apparatus, which is especially useful for alternating currents, is a small paper condenser, which he describes, for compensating the electrostatic capacities. To compensate for polarization, according to the suggestion of Nernst, a polarization cell is added to the metallic resistance, and for this purpose electrodes, which may be dipped into a liquid, may be used; the liquid is sulphuric acid at its best conductivity, and the electrodes are inserted to adjust for the minimum current in the telephone, which is used in connection with the bridge.

Hot Wire Mirror Galvanometer. Herkt. *Elek. Zeit.*, Dec. 19.—Referring to the recent article of Mr. Friese (*Digest*, Dec. 7 and 28), he states that he also experimented with mirror galvanometers, using a Cardew wire, of an alloy of platinum and silver, having a length of 1 m, a diameter of 0.63 mm, and a resistance of 82.3 ohms, and found from repeated calibrations that it has no constant; that is, that the current is not independent of the deflection, and that its value increases with the deflection by an amount averaging 10 per cent. He has found that the following formula expresses the relation within sufficiently close limits:

$$C = \frac{K}{1 - an}\sqrt{n}$$

It gives the value of the current in terms of a constant K, the deflection n and another constant a, whose value is about 0.00035.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraph Line in Formosa. Elec. Friend (Japan), October.—There are two telegraph lines each 62 miles long, running along steam railways constructed by the Chinese before the war; there are five Latmer Clark instruments and one Siemens & Halske. The issue for November states that 82 knots of shore end cable and 1306 knots of deep sea cable are to be bought by the Japanese Government from England.

Telephony at Hong Kong. Elec. Friend (Japan), October.—There are 200 subscribers; No. 16 B. W. G. bronze wires are used; also the Standard switchboard.

Municipal Telephony. Bennett. Lond. *Elec. Rev.*, Dec. 20.—First part of a reprint of the discussion of this paper (*Digest*, Dec. 14).

Telephony in Japan. Elec Friend (Japan), November.—The total number of calls at the telephone calling offices (presumably the public stations are meant), excluding the calls of subscribers, during July, 1895, was 20,157, the charge for which was $1447.

MISCELLANEOUS.

Electro-Pneumatic Brake. Chapsal. *L'Ind. Elec.*, Dec. 10; abstract of a paper by Mr. Lesourd read before the French Society of Civil Engineers.—The system is especially adapted for long trains which are supplied with compressed air brakes, in which both electricity and air are used; it is different from other like systems in that the pneumatic and the electric action are intimately connected and are always simultaneous; the latter aids the former, and it renders the action of the brake absolutely independent of the number of cars; it furthermore enables the pressure of the brakes to be regulated both in putting them on and taking them off; it avoids the very sudden action of the brakes; it can be applied to all existing systems of air brakes; it appears that two wires running the whole length of the train are required; no description of the system is given in the abstract.

Are We Educating Too Many Electricians? Floy. *Eng Mag.*, January.—He believes that public attention has been unduly attracted to and concentrated on things electrical, and that the fad has become a serious mania; he considers it the duty of those who realize the situation to set about correcting the misconception; he is convinced that there is a continued overproduction of electrical engineers; he refers to a previous article by him in The Electrical World, and answers some criticisms on it by Mr. Atkinson; over 1200 young men are annually graduated in this country as electrical engineers; we are not concerned with the ratio of electricians to other professional men, but with the ratio of electricians to the number of positions available; in the majority of cases the positions secured by graduates in electrical engineering are no more attractive financially than a thousand opportunities in other and longer established lines of business. He recently sent out 260 letters to last year's (1895) graduates in electrical, mechanical and civil engineering, from Cornell and Lehigh Universities and the Massachusetts Institute, asking a number of questions, the replies to which are summarized and averaged in a table, from which it appears that while a greater per centage of the graduates in electrical engineering secure employment as compared with the others, yet the fewest relatively secure employment in the line of work for which they had studied, that is, to get employment, they had to take positions in which their electrical knowledge did not count; almost twice as many men secured employment in electrical engineering through the influence of their relatives, as in the mechanical or civil engineering, while about half as many obtained positions through their friends; the working day averages about the same; the electrical graduate receives over 20 per cent. less per hour than the mechanical graduate and 23 per cent. less than the civil graduate, who is the best paid of all.

Globular Lightning. Marsh. *Amer. Jour. of Sc.*—He gives briefly a record of an observation of globular lightning made by him some years ago. He was on board a large yacht in the harbor of Southampton, England; a violent thunderstorm came up, and he noticed a bright light apparently near the upper part of the foremast; it was about half-mast high, and was falling slowly and directly toward the deck; it was a ball of fire, a delicate rose-pink in color, pear-shaped in form with the large end below, and appeared to be 4 or 5 inches in diameter, and 6 or 8 inches in length; it struck the deck about 40 feet from where he was standing, with a loud explosion; an officer was knocked down, but he soon recovered; a strong ozone-like odor was noticed immediately after the explosion; one of the officers said he saw streaks of lightning running around the deck like snakes; the present writer saw distinctly that the forward deck was illuminated with a bright, confused light; no permanent marks were left on the deck where the ball exploded.

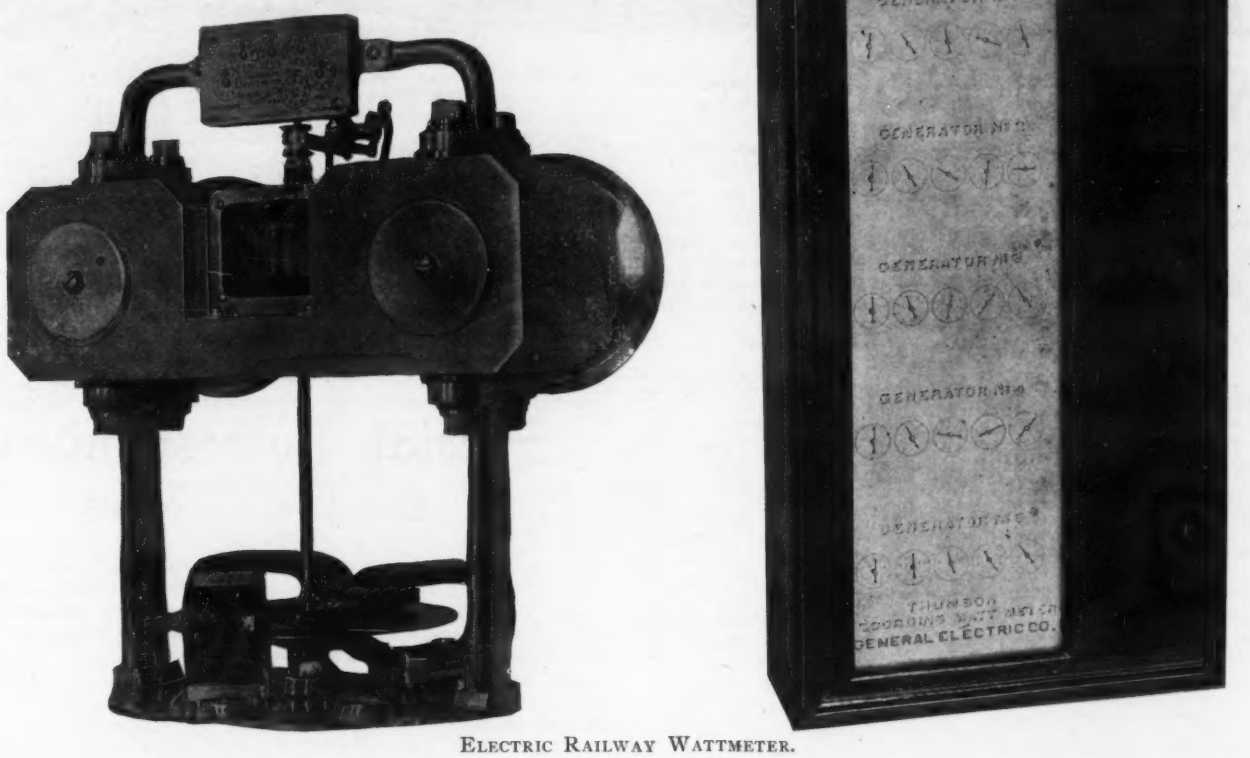
Biographical. Elec. Jour., Jan. 1.—Full-page portrait of Alexander Graham Bell.

New Book.

Poor's Manual of the Railroads of the United States. 1895. New York: H. V. & H. W. Poor. 1412 pages. Price, $7.50.

Poor's Manual of Railroads for 1895 has appeared in its usual completeness. The contents of this volume are as follows: Statements of steam railways in the United States, railways in the Dominion of Canada, chief railways in Mexico, city and suburban tramways of Massachusetts, New York and Pennsylvania; department of street surface railways, statements of miscellaneous corporations, industrial and financial resources of the United States, statements of State and municipal indebtedness, and a supplement containing information too late to be classified. The work involves 1412 pages and 20 maps. As is well-known, every road and branch thereof is specialized. The line of road, history, rolling stock,

operation, directors and financial statement are given under each division. The book is thoroughly indexed so that desired data can be at once found. The information is presented in two sections; the first, comprising all the steam railways of the United States, Canada and Mexico, is included in 1019 pages. Next, the statement of the street railways and traction companies are set forth, followed by those of leading industrial corporations, auxiliary to the railway interests. Many of the railways comprise lines whose names have been changed or which have been acquired by other companies. The Manual takes account of all these changes of management. The well-known and standard nature of the work makes it difficult to review any but familiar matters. The present edition is an apparent improvement over all others.



ELECTRIC RAILWAY WATTMETER.

Railway Wattmeters.

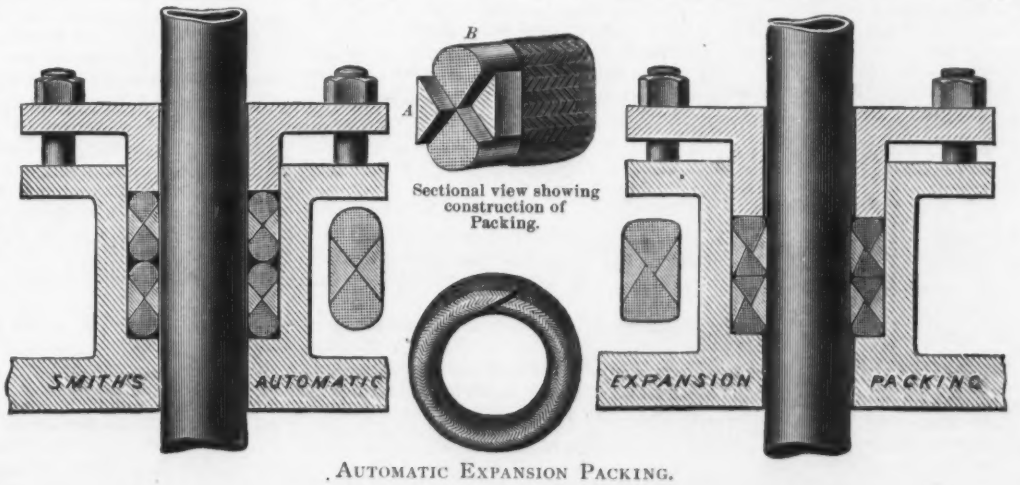
In railway power stations using Thomson recording wattmeters to measure the total output from each machine, or upon each feeder, the grouping of the dials of all the meters in one place where they could be conveniently read at one time has been frequently urged as advantageous. The General Electric Company has, therefore, brought out a "telltale dial" system, which is illustrated herewith. This permits the placing of all the dials upon one panel and the installation of the meters out of ordinary reach, if it be not necessary to read them each day. The necessary wiring from the meters to the panel is simple and inexpensive. The panels can be duplicated and the performance of the meters be read either in the dynamo room or in the manager's office, or any other desired place. Each row of dials on the panel represents a single generator or feeder, and the recording indicator is actuated every kilowatt-hour by a simple make-and-break device upon the meter measuring its circuit. Thedials are several times larger than those on the ordinary meter, and are all direct reading, constants being eliminated by modifications of the actuating mechanism.

The introduction of this telltale system renders the use of a complete system of station-output meters possible in many stations hitherto unable to use them on account of the difficulty in installing them where they can be easily read. The station-output meter is constructed upon the sameprinciple as the recording wattmeter, the construction undergoing modification, however, to adapt the instrument to the conditions imposed by extremely heavy loads. The entire current passes through the field, so that any error which might result from the use of a high-capacity shunt is eliminated.

These meters are adapted for direct application to the switchboard; the studs supporting the meter pass through the board and the bus-bars and form the electrical connection. The conducting parts are of forged copper. The instruments are made in three sizes, to pass 2500, 5000 and 8000 amperes respectively.

Automatic Expansion Packing.

The packing shown in the accompanying illustration, known as "Automatic Expansion" packing, and made by James Smith & Co., 411 Race Street, Philadelphia, is composed of opposite triangular, or half round strips, *A*, of a hard fibrous or other material which are disposed point to point, or with the flattened surfaces, one next to the wall of the stuffing box, and the other in contact with the piston rod, in the upper and lower spaces thus formed; between these strips is inserted packing of a softer material, either square, round or wedge-shape, as shown at *B*, which, by the application of a slight pressure, will fill the entire space, and thereby form an elastic cushion for the harder material to automatically follow up any wear there may be on the rod or packing. The strips *A* and *B* are enclosed in a fibrous covering to confine them in their proper relations to each other until the packing is securely placed in the stuffing box; both hard and soft strips are saturated with plumbago or some other suitable lubricant. The main feature of the packing is the elasticity which comes from its peculiar construction. A slight pressure will expand it laterally to an extent that will make it effective in stuffing boxes varying in size, one size thus displacing two or three sizes of ordinary packing.



Sectional view showing construction of Packing.

AUTOMATIC EXPANSION PACKING.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 4, 1896.

AMERICAN BELL opened fairly strong on Monday and closed at 203. The instrument output report for the month ended Dec. 20, which was published on Monday, shows a net output of 6356 instruments, as compared with 1784 for the same period in 1894. At that time the status of the company's patent affairs was much less favorable than now, which accounts largely for the increase in output.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	..	..
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	24½	25
Electric Storage, pref	100	25	26
General Electric	100	24⅞	25
General Electric, pref	100	60	63
Westinghouse Consolidated, com	50	30	31
" " pref	50	54	54½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	197	198
American District Telegraph	100	33	40
American Telegraph & Cable	100	90	95
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
Erie Telephone	100	60⅛	60¾
Gold & Stock Telegraph	100	105	..
New England Telephone	100	87	88
Postal Telegraph-Cable	100	82	83
Western Union Telegraph	100	83¼	83⅜

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	15¾	16
Binghamton RR. com	100	100	..
Brooklyn Traction	100	7	10
" " pref	100	52	55
Buffalo St. Ry	100	69	71
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60¾
Columbus St. Ry	100	45	50
Hestonville	100	50	..
Long Island Traction, all pd	100	17½	18
New Orleans Traction	100	17	19
" " pref	100	65	68
North Shore Traction	100	20	30
" " pref	100	..	80
†Philadelphia Traction	50	64	64⅓
Rochester St. Ry	..	25	30
Steinway, Ry	..	50	..
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	10⅝	11
West End, Boston	100	66¼	66¾
" " pref	100	93	..
Worcester Traction	100	14	16
" " pref	100	84	86

BONDS.

Buffalo St. Ry. 1st con. 5s	100	102	104
*Binghamton Railway Co. 5s	100	99	100
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	..	100
Rochester St. Ry. 1st 5s	100	102½	104
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Rights.

THE TRACTIONS.—The past week has been exceptionally dull in all classes of traction securities. The demand which has been noticeable of late in certain issues appears to have subsided, and prices have changed on little trading.

THE BROOKLYN STOCKS.—Both Brooklyn City and Brooklyn Traction have again sold off, the former to 168. Transactions in the latter have been few, but the bid price for both the common and preferred has receded about two points. The struggle between the various Brooklyn roads to obtain franchises for additional streets has been settled, temporarily, at least, by the decision of the retiring Board of Aldermen refusing to give to either company the desired privilege.

LONG ISLAND TRACTION.—The refusal of Justice Gaynor to appoint another receiver for the Long Island Traction Company renders the reorganization of the system now possible. The stock, as a consequence, has been selling somewhat higher.

BUFFALO RAILWAY stock early in the week reacted somewhat from last week's highest, but recovered toward the close. Sales are reported at 70, at about which figure it continues in good demand. Transactions have been larger than for some weeks past. The advance is variously attributed to the very vigorous opposition recently developed against granting the new company a franchise, and the unexpected strength shown by the friends of the old road in the arguments before the Railway Commissioners.

CITIZENS' STREET RAILWAY.—The continued and sharp decline in Citizens' (Indianapolis) stock is presumably accounted for by the failure of a large trust company in Philadelphia, which has been more or less identified with the security. This stock sold some few weeks ago as high as 55, while to-day transactions were reported as low as 25. At the close, however, a good demand developed around 27, and on fairly large sales the stock continued firm at about that figure.

NEW ORLEANS TRACTION securities hold fairly firm at somewhat higher prices. The completion of the funding of the floating debt, which will be accomplished in the near future, it is said, by the sale of the last of the bonds, should cause a general advance in the stocks.

Special Correspondence.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Jan. 4, 1896.

MR. C. A. BEAL, of the Mason Regulator Company, Boston, who has been quite ill for several weeks, is now rapidly recovering, information which will be received with pleasure by his numerous friends.

MR. C. B. PRICE, general manager of the Pettingell-Andrews Co., is in New York on business this week—wideawake as ever to secure all possible business and advantages for his company. A strong combination that, Mr. D. A. Andrews and Mr. Price, and a credit to the electrical supply business.

THE AMERICAN ELECTRIC COMPANY, Boston, has reorganized; its office and factory is now located at 50 Hartford Street, that city, and the "New Era" Electric Gas Lighter will be pushed with old-time vigor under the energetic direction of Mr. H. A. Pinkham, to whose ingenuity the public are indebted for the most important and valuable devices.

ELECTRIC POTENTIAL CLUB.—A meeting and dinner of this club is announced for Tuesday evening, Jan. 21, at 6 o'clock, at the Quincy House, Boston. The occasion will be made of especial interest in that Mr. F. P. Addicks, engineer of the Bay State Gas Company, of Boston, will deliver an address on "Acetylene Gas," and prominent electrical and gas engineers will be present to participate in the discussion which will follow.

MR. NORMAN MARSHALL, vice-president of the Anchor Electric Company, Boston, was married Dec. 12, 1895, at Mobile, to Miss Marie Hortense Carver, an estimable young lady of that city. If ever the old saying, "Keep your mouth as the shell of the oyster," was perfectly exemplified, it has been in this instance, but just the same our own congratulations are of course joined with those of his numerous friends, all of whom wish for him and his bride the fullness of happiness and uninterrupted prosperity.

MR. GEORGE LINTON, of Linton & Southwick, Worcester, Mass., manufacturers of switches and switchboards, made this office a pleasant call this week, and reports that the year 1896 opens up splendidly for his firm. The year 1895 was exceptionally prosperous, requiring a considerable increase of factory facilities and working force, and which are now being again increased. These conditions are of exceeding credit to Mr. Linton, who is a young man, and who has secured them though well-directed energy and pluck.

THE PAGE BELTING COMPANY.—Mr. J. H. Burghardt, who for several years past has had charge of the Boston branch of this well-known company, and who has built up an enviable business for it, and made hosts of friends for himself as well as the company, has recently been elected to the important position of its managing director, a deserved advancement, and a position he is in every way qualified to fill creditably. Other executive changes have also been made, the position of actuary being created, and Mr. William Owen elected to fill the place instead of general manager and treasurer, Mr. C. T. Page being made treasurer.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Jan. 3, 1896.

MR. JAMES E. KEELYN, president of the Western Telephone Construction Company, has just returned from a flying trip to Iowa.

THE GRAPHITE RHEOSTAT COMPANY, 1129 and 1130 Monadnock Block, has just received a large order from Paris, France.

CHAS. H. BESLEY & CO., North Canal Street, are headquarters for metals and tools, and invite all interested to write for their 250-page illustrated catalogue.

JOHN R. MARKLE, who was so long identified in the electrical business, went to Idaho last summer to attend to some mining interests. He has

returned to Chicago, and reports his mining interests to be in a prosperous condition. He will remain here until Spring, when he will go back to continue the development of his mines.

THE METROPOLITAN ELECTRIC COMPANY opens the year with a strong hold on Western trade. Mr. Wm. H. McKinlock, president, has been in the electrical business from its earliest stages, and his wide experience and extensive acquaintance is of great service to his company. Mr. McKinlock is justly proud of the new Metropolitan catalogue, which his friends describe as "the largest, handsomest and most complete electrical supply catalogue ever issued, an encyclopædia of all other catalogues, a reference book of everything electrical."

PIERCE & RICHARDSON, 1409 Manhattan Building, report plenty of work on hand. The firm has been engaged by the city of Henderson, Ky., as consulting engineers for the proposed municipal electric light station. The city will install from 150 to 200 arc lights for street lighting, park and commercial service. Specifications will be ready about the middle of January. The Jacksonville Telephone Company, Jacksonville, Fla., has well under way its work of installing a complete telephone exchange of some 600 subscribers. Pierce & Richardson are the consulting engineers for this company also.

THE AMERICAN GAS ENGINE & ELECTRIC COMPANY has applied for an electric lighting franchise in Chicago, promising that, if granted, it will only charge a maximum rate of .8 cent per hour for 16-cp incandescent lamps, and will agree to pay 2 per cent. of its gross receipts for the first 10 years, and 3 per cent. of the same for the ensuing 15 years, into the city treasury. This company was originally organized about seven months ago, with the announced intention of selling gas engines to be used in the maintenance of isolated plants, the real intention having been, it is said, to do block lighting. The *Chronicle*, of this city, asserts that the real object of the company is to force the Chicago Edison Company to buy its stock, but President Insull declines to affirm or deny that the Edison Company had been offered the stock.

CANADIAN NOTES.

MONTREAL, CAN., Jan. 3, 1896.

HULL, QUE.—The Council cannot establish an electric light plant, as the franchise granted to Thos. Nian covers the privilege.

MILLBROOK, ONT.—The Millbrook Electric Light Company was incorporated, with a capital of $6500, to carry on general lighting business.

ROSSLAND, B. C.—F. M. McLeod has given notice of application to incorporate a company to operate electric light and water-works systems.

MONTREAL, QUE.—The Northern Electric & Manufacturing Company was incorporated, with a capital of $50,000, to manufacture brass, copper, etc.

VANCOUVER, B. C.—The British Columbia Southern Railway Company gives notice of intention to apply for an extension of time for the completion of the road.

FRASERVILLE, QUE.—The Fraserville Electric Power Company is applying for incorporation to operate telephone lines, electric light plants, etc.; capital $25,000.

SHERBROOKE, QUE.—H. B. Brown, city attorney, and D. McNanamy were in Quebec last week in connection with the proposed electric railway. The necessary capital, it is hoped, will shortly be subscribed.

QUEBEC, QUE.—The Quebec & Montmorency Electric Power Company is considering a proposal to light public buildings in Levis, and to convey the electric current across the St. Lawrence for the purpose by means of a cable laid at the bottom of the river.

OTTAWA, ONT.—Dr. F. W. Strange and Messrs. J. C. Strokes, L. E. Hambly and A. B. Armstrong, of Toronto, had an interview last week with the Premier regarding the granting of a charter for the proposed electric or steam railway between Aurora and Schomberg.

General News.

TELEGRAPH AND TELEPHONE.

MILLERSBURG, KY.—Millersburg is trying to get on the telephone line to Cincinnati.

KANSAS CITY, MO.—Kansas City will soon have telephone connections with Iowa and Nebraska cities.

WELLS, MINN.—W. Z. Laight and Electrician Morse have been here, seeing about making plans for the building of a telephone line to Wells.

KEENE, N. H.—The New England Telephone Company is completing a line from West Keene to Putney, Vt. Several copper circuits will be set from Keene to Bellows Falls, Rutland, Burlington, St. Albans and other places.

SHENANDOAH, PA.—The Shamokin Valley Telephone Company will at once commence erecting poles and expects to have the line ready within a month. The line will connect Shamokin, Sunbury, Mt. Carmel, and other towns in that county.

COLORADO SPRINGS, COL.—The Colorado Automatic Telephone Company, located at Colorado Springs, has just secured a franchise for telephone purposes in that city. Six telephones are to be furnished to the city, and as many more at half rates as may be required by the City Council. The company has 30 days in which to accept the resolution, and nine months in which to complete the exchange. They will not put wires in conduits until all companies are compelled to do so by the City Council. The life of the resolution is 20 years. Rates are to be $30 for residences and $40 for places of business. Long-distance, copper metallic circuit-instruments are used in connection with Strowger automatic telephone exchange switches. Construction will commence immediately. The completed exchange will start with about 500 subscribers, double the numbers now using Bell instruments. Nearly that many three-year contracts have already been recured. The president of the company, James F. Burns, and three of its directors, own a controlling interest in the famous Portland gold mine, the largest producing mining property at Cripple Creek, from which, it is claimed on fairly good authority, that the former has a daily income of $4000.

ELECTRIC LIGHT AND POWER.

BURKELEY, CAL.—The grounds of the State University will be lighted by electricity.

KANSAS CITY, MO.—The Southwestern Light Company is to take the place of two companies in adjoining towns in Southern Missouri for the supply of electric lights.

TACOMA, WASH.—The University of Washington, at Tacoma, is putting in an isolated electric light plant. The power is supplied by a Ball engine made by the Ball Engine Company, Erie, Pa.

ALLIANCE, O.—A number of Pennsylvania officials have been in the city looking over the company's right of way, preparatory to the erection of a new electric light plant. Work on the plant will probably be begun soon.

BOULDER, COL.—The new electric light company, known as The Western Electric Transit & Powder Co., is advertising for poles and the erection of same. The plant is to be located near the mouth of Boulder Canon, and will be run by water-power.

CAMP HILL, PA.—The Chief Burgess of Camp Hill has returned, without his approval, the ordinance granting a franchise to the Cumberland Light, Heat & Power Company, of Riverton, for lighting the town by electricity. A majority vote in Council sustained the veto.

WHITESTONE, L. I., N. Y.—Water Commissioner Joyce, of Whitestone, is preparing an estimate of the cost of lighting the public streets by electricity. It is probable that when the plans and estimates are submitted to the Board of Village Trustees for consideration, a public election will be called to decide the question.

MILFORD, MASS.—The Milford Electric Light & Power Company is negotiating with the new electric railway company to have the power for the electric light and motor system of the former company generated at the new power-house of the electric railway. It is claimed that the new company will be able to furnish the power required at a much reduced cost.

MINNEAPOLIS, MINN.—The S. E. Olson Company, of Minneapolis, have a large electric light and power plant in their store building. They have recently increased it by the addition of a 100-hp engine of the Ball Engine Company, Erie, Pa., manufacture, being a duplicate of two others which they already have in operation.

OWENSBORO, KY.—The city expects to get a favorable decision from the Court of Appeals reversing the opinion of Judge Owen on the question of issuing bonds for the proposed electric light plant. If the opinion is in favor of the city, the work will immediately commence, and the plant will be pushed to an early completion.

ROME, N. Y.—The merchants and professional men of this place held a meeting in Village Hall, and discussed the feasibility of organizing another electric light company. As a preliminary move, they finally appointed a committee, consisting of T. R. Burrows, J. W. Bright, Dr. W. R. Starks, F. P. Salton and Isaac Sonn, to report at the next meeting.

ALAMEDA, CAL.—The Board of Municipal Trustees met in executive session to consider plans for an addition to the city's electric plant. A lot has been purchased which adjoins the oil works, and the buildings and new electrical machinery will involve an estimated outlay of $15,000. The incandescent plant will be increased to 4000 lamps, and the arc plant to 160, nearly doubling both. New dynamos, engines and boilers will be put in.

BALTIMORE, MD.—J. Frank Morrison, general manager of the newly incorporated Edison Electric Illuminating Company, is superintending an extension of the West Pratt Street plant, which had already been determined on by the Maryland Electric Company, before the consolidation with the International District Telegraph Construction Company. The new plant, plans for which will be prepared shortly, is to supply light, heat and power by the Edison system, with all wires underground.

THE ELECTRIC RAILWAY.

LEBANON, PA.—J. M. Shenk, of Lebanon, and other Philadelphia capitalists are desirous of connecting Reading and Lebanon by an electric railway system.

CHARLEVOIX, MICH.—Charles Gabriel, manager of the electric light company, has asked the Village Council for a franchise for an electric road to run between the two resorts, the depot and the park.

WINCHESTER, MASS.—The selectmen of this place have finally granted terms favorable to Col. Woodward, of Wakefield, and the building of the Mystic Valley Railway will be commenced in the early Spring.

MEADVILLE, PA.—The Meadville & Saegerstown Railway Company will build an electric railway four miles long, the route being from the city limits of Meadville, along the plank road, north to the Pfeiffertown School.

KINGSTON, N. Y.—The persons who propose to build the electric road from Kingston to the Lake now think of running it parallel with and on the west side of the West Shore Railway track to Lake Katrine station and from there to the Lake.

CLEVELAND, O.—The Cleveland & Chagrin Falls Electric Railway Company has been authorized to build and operate an electric railway for the transportation of passengers, freight, mail and express between Cleveland and Chagrin Falls.

PIERRE, S. D.—Applications will be made to the Councils of Pierre and Fort Pierre, for a street railway franchise for a road to connect the two cities. It is intended to cross by the pontoon bridge in Summer and to lay a track on the ice in Winter.

NEW YORK CITY.—The Union Electric Railway Company has made application to the White Plains Board of Village Trustees for the privilege of extending its line from Mount Vernon through Tuckahoe, Bronxville and Scarsdale to White Plains.

SOUTHBRIDGE, MASS.—Permission has been granted for the construction of a single-track railway with necessary switches and sidings from the Sturbridge line on the main highway, between Southbridge and Sturbridge to a point opposite the Fiskdale House.

ALBANY, N. Y.—The State Railway Commission will hear the application of the Albany, Holderberg & Schoharie Electric Railway Company for leave to construct a railway to be operated by steam, electricity or compressed air in the counties of Albany and Schoharie.

SAEGERSTOWN, PA.—The Saegerstown & Venango Street Railway Company, recently chartered, proposes to build a line three miles long through the borough of Saegerstown and thence west to the plank road, through the borough of Venango and over the French Creek Bridge.

AMHERST, MASS.—At a meeting in the interest of the electric railway to Sunderland it was announced that $20,000 had been subscribed in the former town and $4000 in the latter. As $40,000 is the amount which the promoters are trying to raise, the success of the enterprise is apparently assured.

SHELBURNE FALLS, MASS.—Business men are agitating in favor of an electric railway to connect Shelburne Falls and Colerain, and passing through Franktown Mills, Shattuckville and Griswoldville. Lorenzo Griswold, Freeman L. Davenport, Chas. W. Hawks and Zopher Woodward are interested

HARRISBURG, PA.—The Latrobe & Ligonier Electric Street Railway Company will build a road 12 miles in length. The route will be from Loyalhanna Creek, through the township of Unity and the boroughs of Youngstown and Ligonier. Edward E. Robbins, of Greensburg, is president of the company.

PASADENA, CAL.—Arrangements have been completed by the electric railway company with E. J. Baldwin to extend the electric road to Santa Anita, from Colorado Street straight out, A. G. Chapman having agreed to open an extension of Colorado Street through his ranch property, 80 feet in width.

MEDFORD, MASS.—A controlling interest in the North Woburn Street Railway, operating between North Woburn and Medford, is reported to have been purchased by the Shaw syndicate, which owns the Wakefield & Stoneham Street Railway system. The North Woburn road will be operated in connection with the syndicate lines.

MONTAGUE, MASS.—At a hearing before the selectmen on the petition of the Montague Street Railway Company for permission to build an electric railway from Montague Centre to connect with the present system at Lake Pleasant, there was no opposition to the project, and there is little doubt but that the franchise will be granted and the road built in the Spring.

NEW HAVEN, CONN.—A high railway authority here confirms a report that the franchise for building a trolley road from Shelton to Stratford, connecting with the Bridgeport Traction Company's lines, has been bought by the Newark, N. J, syndicate, which controls the latter corporation. The proposed line is to be seven miles long, and is to connect Ansonia and Shelton with Bridgeport.

PHILADELPHIA, PA.—It is expected that work will be begun at once on the new Delaware & Schuylkill Passenger Electric Railway with the intention of having it in operation by Spring. Plans for the new road were prepared by Chief Engineer A. Langstaff Johnston, and have been partly approved by the Board of Highway Supervisors. The new railway is to be eight miles in length. Henry C Forrest is president of the company.

HOMESTEAD, PA.—It is understood to be the intention of the Homestead & Highland Company to extend its lines from its present terminus in Homestead, up through Munhall, a distance of one and a half miles, to the end of the proposed Rankin Bridge, at Harden station, on what is known as the Run Road. The charter was taken out several months ago, and it is said the Homestead & Highland Company has for some weeks been negotiating for the purchase of the charter rights.

CHICAGO, ILL.—C. R. Cummings, representing the South Chicago Street Railway Company, has purchased the Hammond, East Chicago & Whiting (Ind.) trolley line. This addition gives the company direct connection with Whiting, Roby, South Chicago and Hammond. A number of improvements will be made at once to place the extension in the best possible condition. A double track air line will be built early in the Spring between Roby and Hammond, shortening the present line between the two towns three miles.

Trade and Industrial Notes.

THE SAMSON CORDAGE WORKS, Boston, has issued a handsome calendar, on which the name of the firm is recalled by a well-executed half-tone engraving of Bonnat's celebrated painting of "Samson and the Lion."

THE AMERICAN REFLECTOR & LIGHTING COMPANY, Franklin Street, Chicago, makes a specialty of glass-lined reflectors for church, theatres, halls, and also pays particular attention to lighting fixtures for theatrical purposes. A steady and satisfactory increase in business is reported,

THE CROCKER-WHEELER ELECTRIC COMPANY will receive at its works at Ampere, N. J., on Jan. 15, 16 and 17. All interested in the subject of the operation of workshops by electric power will find much to interest them at these works, which embody the latest thought in this application of electric power.

THE TERRE HAUTE CAR WORKS COMPANY, Terre Haute, Ind., announces that on or about Feb. 1, the works will be started at nearly full capacity, after practically two years' idleness. The plant has been enlarged and improved, and it is expected before long more than 1000 men will be employed.

THE AMERICAN ELECTRIC FUSE COMPANY, of Chicago, is increasing its facilities for the manufacture of the now so well and favorably known "American Solid Joint," which it claims is the only absolute air-tight joint on the market. It is also kept very busy on experimental and general electrical supply work, and is making quite a number of novel and electrical specialties.

THE CHAS. E. GREGORY COMPANY, Chicago, under the management of Mr. A. Louis Kuehmsted, makes a handsome showing in a list of recent sales. We find included 14 motors, ranging from 1 to 25 hp, 8 incandescent dynamos of from 60 to 300 lamps, 3 arc machines of 30, 50 and 50 lights respectively, 40 arc lamps and an arc motor. Considering the season, this is a good record.

THE FALKENAU ENGINEERING COMPANY, Philadelphia, Pa., in order to meet the demands of its increasing business has found it necessary to secure additional office room, as well as a stock room in the near vicinity. It will, therefore, on Jan. 1, 1896, remove its offices to suite 711, Reading Terminal Building, and the stock room to the basement of the Reading Market, with entrance from Arch to Cuthbert Streets.

THE VIADUCT MANUFACTURING COMPANY, Baltimore, Md., sends us a handsome colored map in colors of New York State. The map is on a large scale, with county divisions distinguished in different colors, and apparently every town above the smallest village is indicated, as well as all railroad lines. The cover also contains a calendar for 1896. To the commercial traveling man and others, this pocket-map will prove very useful.

THE DIAMOND MACHINE COMPANY, of Providence, R. I., has recently moved its department for the manufacture of leather-covered wood-polishing wheels into a new building, especially built and adapted to this purpose, thereby more than doubling its capacity for the manufacture of these goods This move has been necessitated by the increased demand for wood wheels, recent orders having been booked for 500 wheels from one firm and 400 from another.

MAST ARMS.—In a catalogue of 48 large pages, T. H. Brady, of New Britain, Conn., describes many forms of mast arms, brackets, hoods, and other arc light fittings. From the catalogue we learn that over 20,000 Brady mast arms are in use in the United States, Europe. Canada and South America. To the arc light station superintendent this pamphlet will be found of interest, containing, as it does, a most extended illustrated list of arc light pole fittings of every kind.

THE WESTERN ELECTRIC COMPANY, of New York and Chicago, with branches in London, Antwerp, Berlin and Paris, is one of the largest manufacturers of electrical apparatus in the world, and its line embraces everything from the largest-sized cable to a No. 40 insulated wire, and from generators of greatest capacity to push-buttons. The officers of the company are well satisfied with the results of their efforts during 1895, and consider the outlook for 1896 satisfactory.

THE ELECTRIC APPLIANCE COMPANY, Chicago, among its agencies, includes bare copper wire, "O. K." weatherproof wire, Packard lamps and converters and Upton arc lamps. In fact a central-station man can step into its store and place his entire order for central-station equipment, outside of his apparatus. This company has also recently been appointed general Western sales agents for the Taunton Copper Manufacturing Company, Taunton, Mass., one of the oldest and largest manufacturers of copper wire in the country.

THE NEW YORK INSULATED WIRE COMPANY, with branches in Chicago, Boston and San Francisco, reports a most satisfactory year's business and a good outlook for 1896. Grimshaw white-core wires, raven white core wires, Grimshaw tapes and vulca ducts have a world-wide reputation. The officers of the company are sound business men, who deserve and hold the good opinion of the entire trade. The untiring energy and personal popularity of Mr. James Wolff, Western sales agent, is an important factor in the success of this company in the West.

T. YEARSLEY, of Philadelphia, the oldest dealer in second-hand electrical machinery, has recently purchased all of the generators and motors used by the Julien Storage Battery Company, of Camden, N. J. He reports business to be as good as possible considering that the "Goldite" influences have the industry of the country so much by the throat. Among his recent sales are a 120-kw alternator to Weissport, Pa.; two 50-kw D. C. generators to the Lehigh Valley Silk Mills, and an installation, including a 12-circuit switchboard, a 50 and 20 kw D. C. generator to the Bromley Brothers' Carpet Company, Philadelphia.

THE CHANDLER & TAYLOR COMPANY, of Indianapolis, Ind., manufactures a high grade of plain slide-valve engine, which is strong, simple and durable. It is capable of high piston speed, as well as high rotative speed, thus making it economical and close in regulation. A large number of these engines have been used in connection with isolated plants with excellent results. Some of the larger sizes have been used for street-car service in smaller cities and towns, but the main use and claim which this company makes for its engines in connection with electric work is its special adaptability for small or moderate sized isolated plants.

CHAIN HOISTS AND CRANES.—Maris Bros., 2343 Callowhill Street, Philadelphia, have issued a new edition of their catalogue describing the various types of hoisting and other handling machinery which they manufacture. Among the points of superiority claimed are the absence of complicated mechanism, the use of direct-acting spur gearing (no worms being employed), small sprocket wheels which always insure a proper seating of the chain, efficient means for self-oiling, etc. It is also claimed that their type of traveling cranes take up less head room than any other made. Managers of central and power stations will find much to interest them in this pamphlet.

JAMES J. MURRAY & CO., Murray Flint Glass Works, Philadelphia, express themselves well pleased with the volume of trade done in 1895. Anticipating a larger trade in 1896, preparations are being made in every department of their business. New designs and shapes in globes and shades, in etched, opalescent, alabaster and colored, for arc and incandescent lamps are now ready. This firm makes a specialty of globes and shades for electric light purposes, the gloss being specially prepared, and made of the very best material. Their goods are used by prominent electric light plants, central stations and the trade throughout the United States, Canada, Mexico, and South America.

THE RUSHMORE DYNAMO WORKS, Jersey City, begin the new year with the brightest prospects and with about all the business they can handle for some time. Among recent shipments are one 900-light, 2000-volt alternator to the Covington Electric Light Company, Covington, O.; one 500-light 110-volt dynamo to the Summit Silk Manufacturing Company, Summit, N. J.; one 125-light 110-volt dynamo to the W. D. Forbes Company, Hoboken; one 600-light 110-volt dynamo to the Lake City Light & Water Company, Lake City, Fla. Orders are reported on hand for a number of larger special machines, includ ng one 800-2000-volt light iron-clad alternator and three 150-kw slow-speed railway generators.

THE NATIONAL PIPE BENDING COMPANY, New Haven, Conn., reports a very successful year's business with the "National" feed-water heater. In the new plant of the Sessions Foundry Company two of these heaters of 350-hp National are installed. One takes the exhaust from both Harris-Corliss

engines before the same reaches the condenser and heats the water up to 125 degrees; the feed-water is then conveyed to an auxiliary heater, through which is passed the exhaust steam from the pumps, and the water is there heated up to 200 degrees, going direct to the boilers. The primary heater is located under the floor, lying between the two engines and condenser and the auxiliary heater is located on the engine room floor, next to the boiler room.

CHAIN BLOCKS.—The Yale & Towne Manufacturing Company, 280 Broadway, New York, has issued a catalogue in handsome cloth covers, with the above title, containing illustrations and descriptions of the various forms of chain block hoisting devices manufactured by it. The numerous types of chain blocks are well illustrated in perspective, and in line with dimensions added. Among the different varieties are differential, duplex and triplex blocks, combination blocks and double lift hoists. Concise technical descriptions accompany the illustrations of the various types, by means of which clear and complete ideas may be obtained of the principles involved, thus enabling the type for a specific class of work to be intelligently chosen and afterwards intelligently used.

A CATALOGUE OF ELECTRIC LIGHT FITTINGS.—No name in the past has been better known among electric light men than "Paiste," and the increasing number of specialties with which that name is connected, shown in a new catalogue issued by the H. T. Paiste Company, Thirty-first and Ludlow Streets, Philadelphia, give assurance that it will continue its prominence in the future. The catalogue is notable for the well-executed wood-cuts and intelligent technical descriptions which it contains, in both of which respects other catalogue makers might well take a lesson. Xentric switches in many patterns. all the various types of lamp sockets, ceiling rosettes and circuit fittings occupy the major portion of the space. A novelty is an arc-light projector and carbon tester, designed to obviate the necessity of looking into the arc-light while testing its mechanism.

F. E. BAILEY & CO., Betz Building, Philadelpia, Pa., has issued a circular bringing to the attention of central and power-station managers the merits of the "Rival" oil purifier, which is claimed to embody the most advanced and scientific principles for the filtration and purification of waste oils. This filter does not contain any filtering compound or material, such as felt, charcoal, etc, which soon become clogged and foul, but purifies through the aid of steam heating by a very complete system of circulation. The same company manufactures an "Automatic Oil-Return System" particularly adapted to large and numerous units, a small pipe from a tank being connected to each bearing and the drip being conveyed to a purifier by a pressure tank, thus making the system entirely automatic. Still another generating room convenience is a purifier and storage tank which the manufacturers believe will repay investigation by large oil consumers.

THE JOHN H. McGOWAN COMPANY, Cincinnati, O., manufacturers of pumping machinery, this year enters on its forty-third year of business. The senior member of the firm, Mr. John H. McGowan, still takes an active part in the business, being the oldest pioneer pump-builder in the country. Through his exceptional talent as an inventor, designer, practical worker and manager, he has labored through the long interval of years, fraught with many seasons of business depressions, and to-day finds him at the head of one of the greatest industrial institutions of the West. The present plant of the firm takes up a total floor space of 60,000 square feet. The product, being of a high grade and embodying many sterling features, some of which are covered by letters patent, have won a distinction among users of pumps, and they have consequently built up an extensive trade. Their identification in the water-works business has been most pronounced, having received about 70 per cent. of the contracts during the past year at the lettings where they were represented.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

THE ELECTRICAL COLLECTION AGENCY recently established at Birmingham, Ala., for the exclusive use of electrical manufacturers and supply dealers, will be welcomed by the trade. Much money has been lost in the South by the credit system being too liberally applied, and the object of the new agency is to protect the manufacturers and the trade generally. It is managed by a gentleman whose 14 years' connection with the Southern trade, coupled with the best of references, assures the accomplishment of its object.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 31, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

552,094. AUTOMATIC ELECTRIC SWITCH; Harry H. Blades, Detroit, Mich. App. filed Sept. 14, 1895. The combination with an electric motor, of a switch governing the admission of current to the motor, a solenoid electro-magnet on an independent shunt circuit, said solenoid having a revolving armature adapted to engage and hold in magnetic clutch an iron flange attached to a switch-lever, a series of resistances arranged to successively make contact with the same switch-lever, and means for automatically retracting the said switch-lever to its initial position when the magnet is de-energized by the cessation of the current.

552,103. MULTIPOLAR ELECTROMAGNET; William P. Daniels, Cologne, Germany. App. filed Sept. 7, 1895. In a lifting magnet the combination with a core, of a plurality of pole-pieces arranged thereon, magnetizing coils wound upon said core between said pole-pieces, and yielding adjustable end pieces or extensions provided upon said pole-pieces.

552,105. APPARATUS FOR AUTOMATICALLY MAINTAINING CURRENT UPON MOVING VEHICLES. Harry E. Day, Brooklyn, N. Y. App. filed May 20, 1895. The combination of a main circuit, a motor interposed in the main circuit, a branch circuit from the main circuit, a motor dynamo in the branch circuit, a second branch circuit from the first mentioned branch circuit, and a storage battery energized by the motor dynamo, whereby current may be maintained through the second branch circuit.

552,153. KEYLESS FIRE ALARM TELEGRAPH BOX; Nathan H. Suren, New York, N. Y. App. filed March 8, 1895. In a keyless fire alarm signal box, the combination with the cut-out switch of the box of the operating handle, and a stud withdrawn by the movement of the operating handle and co-operating with the cut-out switch.

552,166. ELECTRIC THERMOSTAT AND PUSH BUTTON; O. F. Woodward, Le Roy, N. Y. App. filed Dec. 29, 1893. In an electric thermostat, the combination of a base with an expansible strip, a movable conducting bar, and an electrode, all supported on the said base in a plane parallel thereto, the said expansible strip and conducting bar being parallel to each other and connected at the free end of the former, and the said electrode being arranged opposite the other end of the said bar for closing the circuit when the said strip expands.

552,172. ELECTROMAGNETIC MECHANISM; S. D. Field, Stockbridge, Mass. App. filed Aug. 5, 1895. In a system of compensating levers, a pair of levers arranged substantially parallel and having abutting faces, one of said faces being curved, and a support for one of the levers adapted to permit longitudinal movement thereon.

552,173. ELECTRIC TELEPHONE; S. D. Field, Stockbridge. Mass. App. filed Aug. 5, 1895. In a telephone the combination with a diaphragm and a device adapted to vibrate therewith, of a system of compensating levers interposed between the diaphragm and the said device and adapted to alter the ratio between vibrations of large amplitude and those of small amplitude.

552,181. ELECTRICAL RAILWAY SIGNALING APPARATUS; H. J Hovey, Evanston, Ill. App. filed Aug. 5, 1895. The combination with two track circuits, each having an electromagnet therein, of a contact, an armature for each of said magnets provided with a deflectible tongue adapted to rest against said contact, the tongue of one armature being adapted to be raised by the movement of the other armature, and an alarm circuit having one limb connected with said contact, and the other with said tongue.

552,190. ELECTRIC ARC-LIGHT; L. B. Marks, New York, N. Y. App. filed Oct. 9, 1894. An arc lamp having a transparent or translucent inclosure around the arc, provided with a small inlet for air and ducts for leading the air in a uniform direction relatively to the arc.

552,211. DEPOLARIZED FOR PRIMARY BATTERIES AND METHODS OF MAKING SAME; Gustav W. Thurnauer, Aurora, Ill. App. filed Feb. 20, 1895. As a new article of manufacture, a depolarizing plate consisting of copper oxide intermixed with copper chloride, the whole forming a compact mass.

552 218. ELECTRIC BATTERY; D. S. Williams, Philadelphia, Pa. App. filed July 19, 1895. The combination in an electric battery of the jar or casing, a cathode formed of a series of separate blocks of a high oxide, connected by a conducting strip, a bottom cup or plate of non-conducting material secured to the base of said cathode, and an anode resting in and supported by said cup or plate.

552,219. ELECTRICAL BATTERY; David S. Williams, Philadelphia, Pa App. filed Aug. 23, 1895. An improved battery consisting of a casing containing an electrolyte, a series of cathodes in said electrolyte, conductive material having an insulated surface in contact with said electrolyte, the cathodes being in electrical connection with said conductive material.

552,220. ELECTRIC BATTERY; D. S. Williams, Philadelphia, Pa. App. filed Aug. 23, 1895. An electric battery comprising an outer shell or casing, a series of partitions inactive to the electrolyte studs, carried in said partitions, cups, on solid studs, and electrodes in said cups.

552,239. SAFETY DEVICE FOR ELECTRIC CIRCUITS; P. H. D'Unger, Chicago, Ill. App. filed Sept. 16, 1895. In combination with an electric circuit, a switch included therein, an induction coil whose primary includes a portion of said circuit, a body of explosive material connected with the switch, and the secondary circuit of the said coil, having its terminals in said explosive and adapted to fire the same.

552,260. APPARATUS FOR TRANSFORMING ALTERNATING-CURRENTS INTO UNI-DIRECTIONAL CURRENTS; C. Pollak, Frankfort-on-the-Main, Germany. App. filed May 22, 1893. The combination, in a commutator, of radical segments or strips, connected in alternating series, strips of one series being insulated from those of the other series, the spaces between the strips increasing in width with the distance from the centre or axis of the commutator, and brushes adjustable in the direction of the length of the strips.

552,271. ELECTRICAL BICYCLE; O. Bolton, Jr., Canton, O. App. filed Sept. 19, 1895. In a bicycle, the battery suspended from the frame, a wire extending from one of its poles, the insulating bearing surfaces upon the post, the rheostat upon the handle-bar, the contact points which bear against the insulating surfaces and connecting wires combined with the wire which extends from the other pole of the battery, the supports to which the contacts are secured.

552,279. ELECTRIC SIGNAL FOR RAILWAYS; E. B. Cutten, New York, N. Y. App. filed April 1, 1891. The combination with a railway track divided by rail insulations into conducting sections or blocks, a resistance bridge introduced between the opposite rails of a block, and an electric generator and signal-receiving magnet adapted to be introduced at a signaling point between the opposite rails of a block, said magnet constructed to give a signal upon reaching a certain excitation, whereby on sending a current over said section it normally excites said magnet to a predetermined extent, but if said interposed resistance be short-circuited by the presence of a car or train on said section, the consequent augumentation of current will increase the excitation of said magnet and give a danger signal.

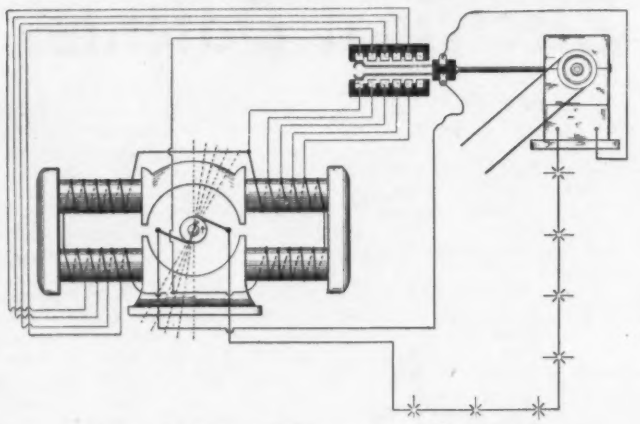
552,309. ELECTRIC METER; J R. Tucker and C. C. Hinckley, Aurora, Ill. App. filed March 25, 1895. In an electric meter, the combination of a register with a device responsive to the main current, a vibratory arm adapted by its movement to actuate said register, and an interrupter located between said vibratory arm and said register and adapted to interrupt the operation of the register at intervals.

552,313. SYNCHRONOUS SINGLE-PHASE MOTOR; C. E. L. Brown, Baden, Switzerland. App. filed Feb. 6, 1893. In an electric motor, the combination with a stationary winding, of a rotating winding, two collectors each connected directly with the rotating winding, and of which one is a multiple-part collector and the other a few-part collector, having as many parts as the machine has poles, the first collector being adapted to be thrown out of action when starting the motor, whereas the second collector serves to act only when synchronism is reached, a pair of brushes in contact with each collector, and proper electrical connections for said brushes.

552,316. ELECTRICAL RAILWAY SIGNALING SYSTEM; T. B. Dixon, Henderson, Ky. App. filed July 10, 1894. In an electrical railway signaling system, the combination with an insulating block or section of track, and an electrically controlled signal controlling the entrance of trains to said block at one end thereof, of a battery at the distant end of said block, and a signal circuit therefore passing through the rails of said section of track, and controlling the signal at the home end of the block, said battery being normally out of said track circuit, and a circuit-controller operated from the home end of said block, and arranged, when operated, to throw said battery into the signal circuit.

552,322. SECONDARY BATTERY; A. S. Krotz and W. W. Spencer, Springfield, O. App. filed Jan. 31, 1895. In a storage or secondary battery plate, a holding material of porous sheets provided with porous projections on the inner side, and an active material intimately compressed into the interstices of the porous sheets and projections and extending through and through at least the sheets to form innumerable exposed attenuated filaments.

552,337. ELECTRIC MOTOR; A. W. Smith, Washington, D. C. App. filed July 23, 1895. In an alternating-current motor, a movable magnetic system wound with two or more independent sets of commutable coils, said sets of coils being angularly displaced from each other, and a commutator for placing said sets of coils in the primary circuit during positions of attraction, and in the secondary circuit during positions of repulsion.



No. 552,397.—REGULATOR FOR DYNAMOS.

552,338. ELECTRICAL RAIL-FISH; V. Thelin, Geneva, Switzerland. App. filed Aug. 1, 1895. The combination with the rails having holes through them near their ends, of tubular plugs to pass through and project beyond the surfaces of the rails and open at both ends, and each having a projecting block and a rod extending from one block to the other, and a taper pin driven through each tubular plug adjacent to the block to press the said block against the rail and spread the plug and prevent the same from being withdrawn.

552,347. MOTOR SUSPENSION FOR STREET CARS; G. F. Card, Mansfield, O. App. filed Aug. 21, 1895. The combination with a motor, of a frame having one end elastically supported upon the car truck, and the other end elastically supported from the car axle, and a pivotal connection of the motor and frame between the points of support of the frame.

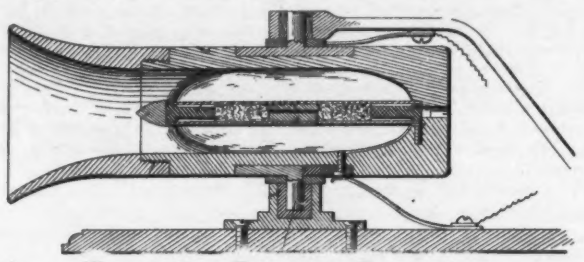
552,363. INSULATING JOINT; E. P. Gleason, Brooklyn, N. Y. App. filed Dec. 27, 1894. In an insulating coupling, two sections having perforated flanges secured together by a turned flange or ring and plugs of non-conducting material extending into the holes in the sections, and insulating material disposed as set forth.

552,369. MEANS FOR OPERATING ELECTRIC RAILWAY VEHICLES; E. G. W. C. Hoffmann, Charlottenburg, Germany. App. filed Sept. 3, 1895. An electric railway vehicle having a rotative bar or shaft adapted for operating current-controlling resistance devices and motor-current reversing devices, one or both, and provided with a longitudinal slot, combined with a coupling device having studs adapted to the slots of the rotative bars or shafts of two vehicles.

552,384. ELECTRIC GAS LIGHTER; P. Meyer, Alameda, Cal. App. filed Sept. 20, 1895. In combination with an atmospheric or Bunsen burner, having its surface of ignition enveloped by a mantle adapted to be rendered incandescent under heat, electrodes centrally disposed upon said ignition surface, and suitable electrical connections for said electrodes.

552,397. REGULATOR FOR DYNAMOS; C. E. Scribner, Chicago, Ill. App. filed June 1, 1889. In a dynamo-electric machine provided with consequent pole-pieces, the combination with symmetrically disposed sectionally-wound field magnet coils, of means for alternating the circuit connections of the sections of said coils to vary the relative magnetizing power of said coils, thereby rotating the entire field of force through the armature about the axis of the armature in a plane perpendicular to said axis; whereby the diameter of maximum commutation is shifted to vary the voltage of the machine.

552,420. SIGNALING AND LOCK-OUT APPARATUS FOR TELEPHONE STATIONS; J. D. Clarke, Chicago, Ill. App. filed April 5, 1895. The combination with a telephone circuit of a combined busy signal and lock-out telephone station apparatus, a support for the receiving telephone, and a circuit-changer actuated by the removal of the receiving telephone from its support, the said busy signal and lock-out apparatus being responsive to the presence on the line of a current of definite direction and the concurrent operation of the circuit-charger.



No. 552,469.—TELEPHONE TRANSMITTER.

552,425. SECONDARY BATTERY; C. A. Faure and F. King, London, Eng. App. filed March 6, 1895. In a secondary battery, the combination with the conducting support carrying the active material, of a sheet or layer of silicated asbestos fabric, and a perforated envelope or cover of acid resisting material, such as ebonite or celluloid, which is kept from contact with the active material by the said silicated asbestos.

552,451. ELECTRIC RAILWAY; M. H. Smith, Halifax, Eng. App. filed Oct. 29, 1887. In a magnetic switch the combination with the pole-pieces, of a pivoted armature, a hook supported from said armature, an electrical connection between the pole-pieces and the armature, and an extension contact piece attached to said armature.

552,464. ENGINE STOP; James Brady, Brooklyn, N. Y. App. filed Feb. 14, 1895. In an engine stop, the combination, of the releasing lever having a spring arm, the rock shaft having a crank-arm provided with a knob, and a supporting arm having a spring arm.

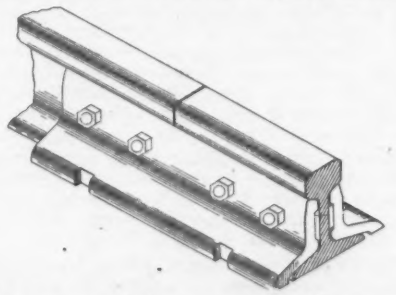
552,469. DOUBLE DIAPHRAGM TELEPHONE TRANSMITTER; D. Drawbaugh, Eberly's Mill, Pa. App. filed Feb. 23, 1895. The combination with a multiple diaphragm transmitter, of an insulating disc separating the diaphragms, a flat elastic or spongiform annulus fitting within an opening in the disc and filling the space between the diaphragms, carbon buttons carried by the diaphragms and fitting in an opening in the annulus, and a body of granular carbon interposed between the buttons.

552,477. RAIL BOND FOR ELECTRIC RAILWAYS; B. J. Jones, Chicago, Ill. App. filed March 29, 1895. A rail-bond for electric railways, comprising a loop-shaped body-portion of a thin, flattened formation in cross-section, and rivet studs arranged to project laterally from the respective ends of the body portion of the bond and adapted to fit orifices in the rail ends, and be secured therein, the construction being such that the loop-shaped body-portion will occupy a vertical plane next to the rail web, and between the same and the fish-plate.

552,479. AN ELECTRIC RAIL-BOND; M. K. Kendall, Melrose, Mass. App. filed Aug. 12, 1895. An electric bond for railway rails, comprising in its construction a strip of conductor metal provided with cross slits, which form points or projections adapted to be forced into a bolt hole in the web of the rail, and tightly wedged therein by the bolt.

552,495. REGULATOR FOR ELECTRIC CIRCUITS; J. C. Mayrhofer, New York, N. Y. App. filed July 5, 1895. In an electric light regulator, the combination with a resistance coil, of a series of commutator plates connected at intervals with the coil, the steps of the commutator increasing in resistance toward the centre, and two contacts having circuit connections movable over said commutator.

552,496. ELECTRIC LIGHTING SYSTEM; Joseph C. Mayrhofer, New York, N. Y. App. filed July 5, 1895. In a theatre-light regulator, the combination with a resistance coil, a series of commutator plates connected at intervals with said coil, and two contacts connected with the supply circuit and movable over said commutator plates, of two or more lamp circuits, and two or more independent switches for connecting one side of each said lamp circuits independently with either end of said resistance coil the other sides of said lamp circuits connected with the supply circuit.



No. 552,479.—ELECTRICAL RAIL BOND.

552,498. ELECTRIC ARC INCANDESCENT LAMP; John A. Mosher, Chicago, Ill. App. filed Sept. 23, 1895. In a composite carbon for electric arc lamps, all portions of which are combustible and electrically conductive the combination with a core, of a body portion superimposed thereon and being, relatively as to the core, of high combustibility and low electric resistance.

552,501. INSULATOR; Charles H. Snively, Mt. Carmel, Pa. App. filed March 20, 1895. The combination with suitably supported insulator blocks, of means for simultaneously clamping the wire between the blocks and stretching the wire.